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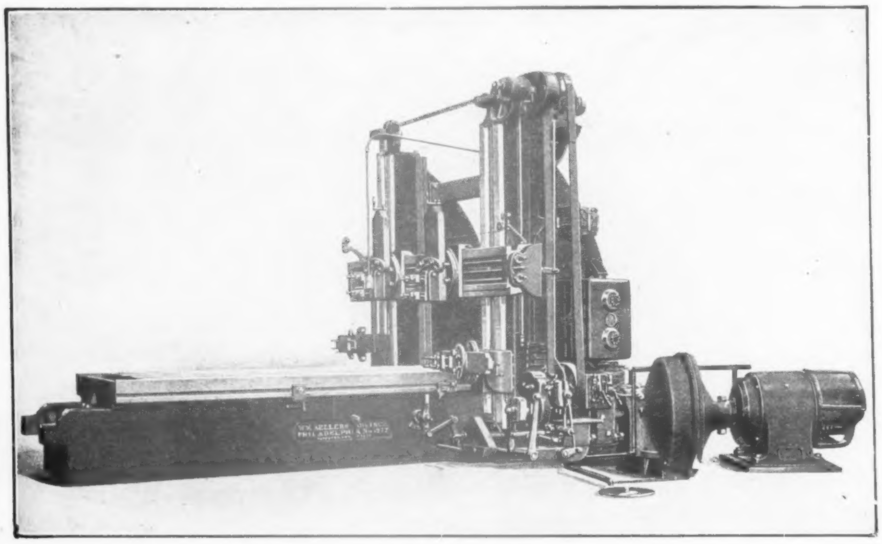

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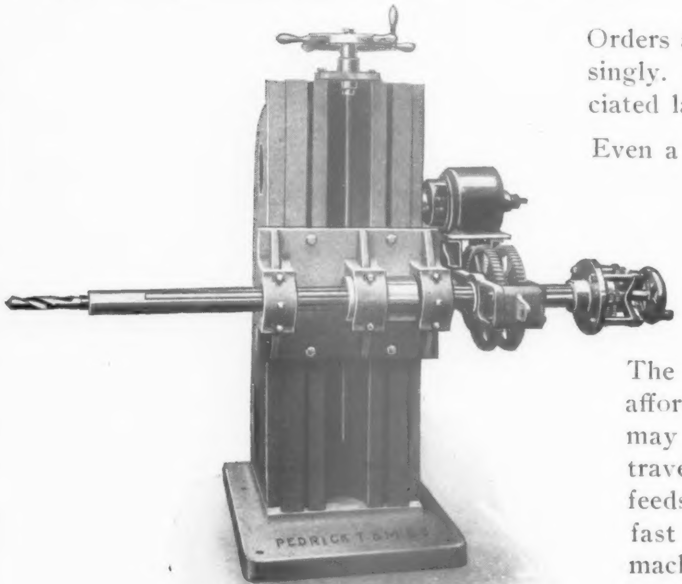

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Wooden Freight Equipment

For the past two years some of the railways in view of the high price of steel and poor deliveries, have gone quite extensively to the use of wood in the construction of freight equipment. The experience of the railroads with some of this equipment has not been at all satisfactory and the situation demands the most careful consideration. It must be remembered that the railways are handling an unprecedented amount of traffic which must be moved with despatch and without delay. It is true the railroads need cars and need them badly, but a car of weak construction that will cause delay to the trains on the road will cost more in the delay to the traffic and the possible damage to other equipment than that car is worth. It is highly essential, therefore, that whatever cars are built be built to withstand the heavy service conditions now prevailing. Examples of wooden cars built only two years ago and which are now unsuitable for further service show that the construction of wooden equipment has not been given the proper consideration.

There is no question but that wood can be used to a large extent where steel was previously used and a good car be built. There is, however, hardly a case where the strictly all-wood car can be used satisfactorily. A certain amount of steel must be used to properly reinforce the wooden members. For instance, it is folly to attempt to build a drop bottom gondola car entirely of wood. The construction of this type of car is such that it can hardly be built to withstand the service to which it is put. Steel underframes should be required on this class of equipment. The house car, however, offers a greater possibility for the more extensive use of wood, but here, metal draft arms, or still better, metal draft sills with the proper arrangement of truss rods should be used.

The demands of the government for adequate equipment require that the most careful consideration be given to this subject. There are no short cuts that can be made to meet the present conditions. Car designers should follow carefully the fundamental principles of good car design. There is no telling how long these extreme demands on the railways are to last; even if the war should end within a year, there is no question but that America would be called upon to give of her resources for the rehabilitation of the countries that have been at war for the past three years. The situation demands the most careful thought and every effort should be made to build substantial equipment which will not clutter up the repair tracks with bad order cars.

Keep the Shop Equipment in Repair

Such are the remarkable conditions in this country at the present time that not infrequently we hear of cases where shop equipment manufacturers find it necessary to make a careful survey of their customers' needs to find out which ones should have their orders filled first for the best interests of the country at large. This immediately raises the question as to whether or not the railways cannot be of assistance to the country as a whole by endeavoring to maintain their shop equipment in better condition than heretofore. It may be found practicable to rebuild the equipment which in the past has been scrapped and replaced, but which can not readily be replaced under present conditions. It is an economic question in which the price of the equipment, the available labor necessary for the work and the facilities for doing the work, must be carefully considered. Some shops maintain what is called the repair gang, which devotes its entire time to the maintenance of the equipment in the shop. Should or should not this gang be increased in force and be provided with additional facilities for doing more extensive work on the shop equipment than it has hitherto been called upon to do? It is a question

the answer to which will be governed by conditions and one which each railroad will have to decide for itself. It should, however, be given consideration. The greatest problem in the railroad shop today is to get the cars and locomotives back into service in the shortest possible time consistent with good workmanship. More time spent in the maintenance of shop equipment and in the increasing of its efficiency, will increase the output and the efficiency of the shop, but the question as to how far these improvements should be made depends, as stated above, upon the availability of new shop equipment, its cost, and the forces necessary to properly do this work.

Support the Committee on National Defense

Many things seem to indicate that of all the industrial and economic forces of the nation, the railroads come nearest to a full realization of what the country must face in the months to come. Not only must they handle a volume of traffic wholly unprecedented with facilities apparently already overtaxed, but they must handle it in the face of an inadequate supply of labor in the maintenance departments, which will be reduced still further by the removal of over three-quarters of a million men from civil pursuits during the next three months. That facilities can be increased in time to relieve the situation seems hardly possible at this time. Therefore the only possible way to meet the demands for transportation is to increase the efficiency of present facilities. A special committee on national defense has been organized by the American Railroad Association to bring about this increased efficiency by operating the railroads practically as a single system. If the committee is properly supported by all the roads there need be no doubt as to the result. In a bulletin issued on May 9, and printed in our June issue a number of expedients whereby remarkable improvements may be brought about in the effectiveness with which existing facilities may be utilized were outlined. The presidents of the railroads have given this committee authority to formulate policies for all or any of the roads during the war. This alone, however, will not solve the transportation problems during the coming months, and possibly years, of the war. Unless every officer, every man, gives the committee his wholehearted and unqualified support in carrying out its suggestions and policies, the railroads will fall short of the full measure of success that can be attained in the present emergency and the nation will play but a halting part in a world crisis. Truly, teamwork is the railroads' supreme patriotic duty to the nation.

Air Compressors in Yards

There are comparatively few freight yards which have facilities for testing brakes before the engine is coupled to the train. This practice has so many advantages, however, from both maintenance and operating standpoints, that it seems that it should be more generally used. It makes it possible to determine the condition of the brakes far enough in advance of the time when cars are to leave to permit proper repairs being made and speeds up the handling of trains by reducing the time they are held at terminals for inspection.

Proper maintenance of the air brake is necessary not only for the sake of safety but also to secure economy of operation. Men who are familiar with the condition of equipment agree that the general standard of air brake maintenance is not what it should be. Brakes cannot be kept in the proper condition unless they are tested before the engine is attached to the train and while a test on all incoming trains is of great assistance in improving the condition, it does not take care of cars received from connecting lines. Shocks resulting from variations in braking power between the cars in different parts of a train are responsible for many breaks-in-two and for other less serious damage to draft gear. It is out of the question to try to adjust the piston travel on a freight train while it is being inspected. Lack of attention to the air brakes also results in loss of fuel due to stuck brakes and leaks in the train line.

It is unreasonble to expect a car inspector to look over a train and correct all the defects in the 15 or 20 minutes usually available between the time when the engine is coupled to the train and when it is scheduled to leave. The inspector is obliged to pass by many defects which should be remedied merely because he has not the time to correct them. It might be argued that by having more inspectors the work could readily be handled after the engine is on the train, but even if a larger force was employed it would hardly be possible to avoid delaying trains. Even though the delay is not long enough to involve any terminal overtime for the train crews it makes it difficult for the despatcher to arrange meeting points and as a result the time the trains are on the road is increased. When all things are considered, the advantages of having air compressors in yards are so evident that their installation seems essential for the economical operation of large freight terminals.

Shortage of Mechanics Threatened

The withdrawal of mechanics from railway service during the past few months has caused a critical situation on some railroads. A large number of men have already been recruited from the roads, both in the railroad regiments and in the regular service, and there is a prospect that more will be drafted. Mechanical officers are viewing with alarm the further depletion of their forces. At this time the urgent demand for locomotives and cars makes the prompt repairing of equipment of the utmost importance and railroad mechanics may perform quite as great a service for their country by remaining at their posts as they could by going to the front.

In England the railroads released about 25 per cent of their normal force of employees for military service and the scarcity of railroad mechanics became so serious that it was found necessary to make them exempt. To avoid if possible a similar situation in this country the Railroads' War Board has asked the Council of National Defense to define the government policy with regard to the enlistment of machinists or other skilled railway employees. In view of the experience of the British roads a consideration of the subject at this time seems advisable.

There is no question that the railroads will be called upon to handle heavier traffic during the war than they ever have before and it is conceded that the highest efficiency in handling this traffic is essential if this country is to do its share in the great struggle. Locomotives and cars will therefore be at a premium. The unusually large proportion of the output of the locomotive and car works of the United States which are being exported to the allied countries will reduce the amount of new rolling stock available for American roads during the war, and for that reason all existing equipment must be kept in efficient condition. This cannot be done unless the car and locomotive repair shops are worked at their full capacity. Therefore a full complement of mechanics is necessary. If skilled workmen are drawn away from the shops in large numbers the efficiency of the railroad systems may be seriously impaired.

Recently a large number of men have left railroad shops to work at the navy yards. In one shop 12 machinists resigned in a single day as a result of the government campaign to secure mechanics. Notices to the effect that men were wanted for service in the navy yards had been distributed at other shop points and the situation became so critical that the government was requested to withdraw them. This was done without delay. The railroads will find it hard to replace

mechanics who leave the shops at this time, as men who have been trained in other industries cannot as a rule be used successfully on railroad work. The navy yards could no doubt use mechanics drawn from other sources, where their positions might be filled by women. Recruiting of mechanics for navy yards from the railroads should be discouraged.

The problem of maintaining the efficiency of the railroads during the war is one which the experience of the Allies will help us to solve. While the situation in the shops has not as yet become acute except on a few roads, mechanical department officers should keep in close touch with the labor situation in order to avoid a disorganization of their forces.

New Departure in Locomotive Design

The design of the Pennsylvania Decapod type locomotive, a description of which is published elsewhere in this issue, involves one of the widest departures from the well worn groove of conventional practice which has ever been undertaken. The constantly growing demand for increased locomotive capacity has led to the successful development or adoption in this country of many labor saving and capacity increasing devices, such as the locomotive stoker, the superheater and brick arch, and yet the ability to continually increase locomotive capacity within the limitations imposed by track conditions and right-of-way clearances has been severely taxed. In the Pennsylvania locomotive the possibility of still further increasing the capacity has been created by eliminating the uneconomical range of cut-offs ordinarily employed at slow and moderate speeds. It is evident that high tractive effort obtained by working the locomotive at full stroke is accompanied by a waste of steam as compared with the expansive use of the steam at higher speeds. The limitation of the maximum cut-off not to exceed 50 per cent at starting and during slow speed operation, the cylinders being increased in size to offset the decrease in mean effective pressure per unit area, offers a most promising field for the conservation of the steam supply which may be utilized to develop increased horsepower for a given boiler size. In this connection, however, the fact should not be overlooked that the stresses on the running gear are increased by this practice, owing to the higher initial piston load necessary to produce a given mean effective piston pressure as compared with that from a full stroke card. This will require somewhat heavier reciprocating parts as well as larger rods and crank pins and may be expected to increase the wear and tear throughout the running gear. These, however, are conditions which it should be possible to take care of without difficulty, especially in the case of freight locomotives, the class of power on which the arrangement under discussion offers the greatest advantages. There are a number of incidental advantages which this arrangement offers, such as a more uniform starting torque and therefore a decreased tendency toward slipping, which will add to the interest with which the thorough testing out of this locomotive in service will be followed by locomotive designers throughout the country. Unless the difficulties of maintenance prove greater than expected, no reason is apparent why the new method of proportioning cylinders and limiting the cut-off should not become a well established feature of American locomotive practice.

Conserve the Motive Power

The need for locomotives was never greater than it is today, and the possibility of obtaining locomotives from the builders was never worse, the best deliveries obtainable being from nine to twelve months. In addition to this, locomotive prices are extremely high, and our Russian allies want 2,000 locomotives from us. "Locomotives, locomotives and still more locomotives" are the fundamental needs of Russia today, Professor Lomonosoff, railroad minister with the Russian mission, told Washington newspaper men in an interview. "Quite frankly I can say to you, our American friends," he said, "give us locomotives and we shall give you military success."

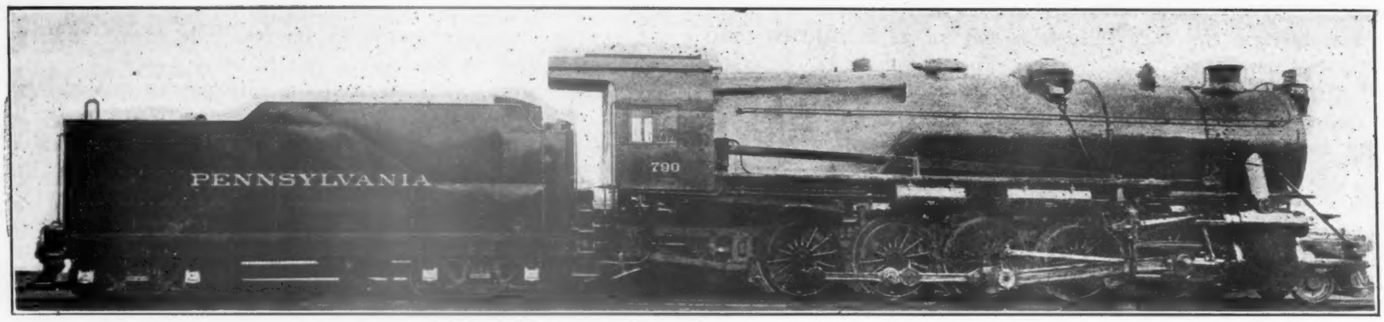
It is, therefore, apparent that the railways in this country are in a very peculiar situation and every means must be taken to get the greatest possible service out of the available power. The Railroads' War Board has asked that the number of locomotives under repair be reduced from 15 to 10 per cent, thereby increasing the number of locomotives available for service by 3,000. In view of the shortage of labor which is being felt the country over, this is a difficult thing to do, but it must be done and every member of the mechanical department of the railways should consider it his patriotic duty to do what he can to reduce the number of locomotives in shop or awaiting repairs and thereby increase the country's supply of motive power. In speeding up the work of locomotive repairs, the quality of the work cannot be sacrificed. An engine failure during this time of congested traffic is expensive and increases the congestion. The workmanship therefore must be at least equally as good as formerly. It is the efficiency of the shops that must be increased and with it, the shop output.

With the prices for new equipment as they are, the advisability of equipping power with capacity increasing devices and other devices which decrease the time a locomotive spends in the shop must be given careful consideration. A thorough economic study should be made of the entire situation so that locomotives may be used to the best advantage and so that money for additional power may be spent where it will produce the greatest returns. Many roads have restricted their passenger service for the purpose of relieving congestion and to increase the available supply of men and material. In some cases passenger locomotives can be used in freight service. Wherever this is done care must be taken not to use them where they will interfere with the expeditious movement of freight. They can be used to advantage in doubleheading on fast freight trains and in releasing fast freight locomotives for use in slower service.

The terminal delay of the locomotive must be reduced. This may be done by a more logical arrangement of the terminal tracks and facilities, by the use of inspection pits, by the consolidation of trains and by running locomotives over two divisions where it is possible to do so. One road has eliminated 34 terminal handlings of locomotives and released 3 locomotives for other service by following the latter practice. This not only increased the availability of power, but materially decreased the fuel consumption costs. It has been estimated that a saving of about six dollars a day was made for each locomotive that covered two divisions.

Whether a road operates on the pooled or assigned system, the enginemen should be made to feel the responsibility they bear to the railways and their country in the present situation. The engine crews should be instructed how to get the most out of their power and supervision should be adequate to see that the instructions are carried out. The engine crews can be of particular assistance and a very great help in making proper and complete work reports at the end of their runs in order that the defects may be promptly located and repairs made with despatch.

It is every man's duty as a citizen, from the helper to the man in charge of the mechanical department, to do his level best on the work assigned to him, to work harder and to use his head as well as his hands in increasing the effectiveness of the motive power on our roads. There is no short cut to the accomplishment of this end. The fundamentals of good locomotive maintenance and operation should be followed more closely even than in the past. Every penny spent on a locomotive must be made to do its bit, every ounce of a man's strength must be used to the best advantage, and every thought regarding the work must go towards increasing efficiency and producing more effective results.

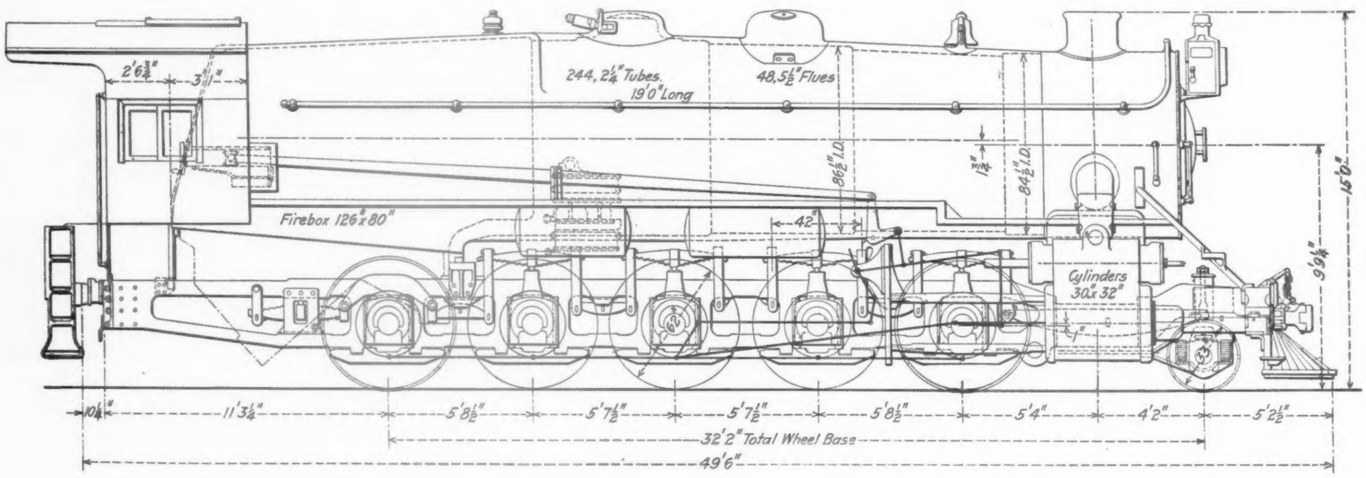


P. R. R. Decapod Type Locomotive

Maximum Cut-Off Is 50 Per Cent; Tractive Effort 80,640 Lb. at 7 M. P. H.; Boiler Pressure 250 Lb.

In December, 1916, a Decapod locomotive having a total weight of 366,500 lb., a weight on drivers of 334,500 lb. and a tractive effort of 80,640 lb. was built by the Pennsylvania Railroad at its Juniata shops. The locomotive is the first of its type to be placed in service on this road and is known as the I-1-s class.

There are several unique features in the design which represent wide departures from customary practice in locomotive engineering. Instead of operating at a maximum cut-off of approximately 90 per cent, the valves have been given a steam lap of two inches and the maximum cut-off with the reverse gear in the corner is 50 per cent. In order to secure a maximum tractive effort in proper relation to the weight on drivers, this necessitates the use of much larger cylinders than are required where 90 per cent cut-off can be obtained. The cylinders are 30 in. in diameter by 32-in. stroke and owing to clearance limitations which prohibit a further increase in the diameter of the cylinders, the boiler pressure was fixed at 250 lb. per sq. in.



Elevation of the Pennsylvania 2-10-0 Type Locomotive

With the notable exception of the high boiler pressure, the Decapod type boiler is of the same general design as that of the class L-1-s Mikados, a large number of which are now in service on the Pennsylvania Railroad.* While there are differences in details, it will be noted by a comparison of the data for the two types given in the accompanying table of dimensions, that there is little difference in the capacity of the two boilers.

The barrel of the boiler has a minimum internal diameter of 82 in. and is made of 1¼-in. plate, 1½-in. rivets in 1 9/16-in. holes being used in the longitudinal joints. Like the Mikado boiler, the main barrel course is made in two halves which are joined on the horizontal center line. The shoulders peculiar to the Belpaire type boiler are flanged integral with the upper half, and the rear end of the lower half is flanged to form the throat sheet. A one-piece pressed dome is mounted on this course. The boiler is fitted with a Schmidt superheater of 48 units placed in 5⅜-in. flues. There are 244 2¼-in. tubes, the length between the tube sheets being 19 ft. The firebox includes a combustion chamber 3 ft. long and is equipped with a firebrick arch.

The smokebox design is generally similar to that of the Mikado type locomotive. The exhaust pipe stands about 21 in. above the bottom of the smokebox and is fitted with a circular nozzle having four internal projections. The ring blower, however, has been removed from the nozzle tip and placed at the choke of the lift pipe, which is 17 in. in diameter. This arrangement is effected by the use of a combined blower ring and lift pipe bell casting, which is shown in detail in one of the drawings.

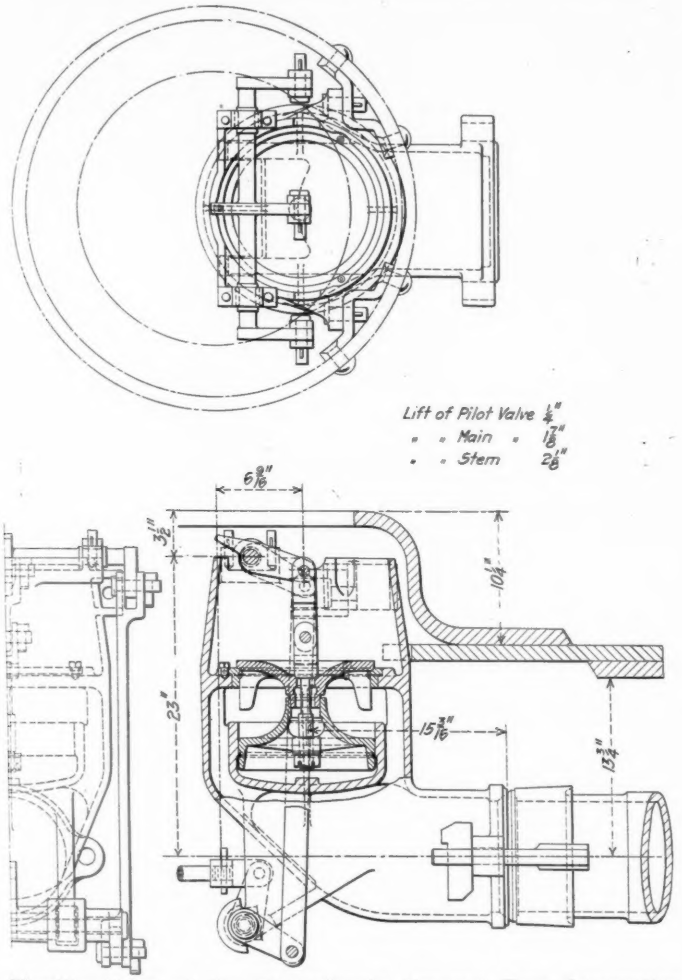
Each of the frames is a single steel casting 44 ft. 8¼ in. long with a driver brake shaft bearing cast integral. The top rail is 7 in. wide by 8 in. deep, the section changing to a width of 9½ in. and a depth of 7½ in. over the jaws; the lower rail is 6 in. deep. The single rail section to which the cylinders are attached is 5½ in. wide by 20 in deep.

Steam is supplied to the cylinders through an 8½-in. dry pipe and 6-in. branch pipes, the admission being controlled by the balanced throttle valve. The steam distribution is con-

* This class was fully illustrated and described in the *Railway Age Gazette, Mechanical Edition* of July, 1914, on page 343.

trolled by 12-in. piston valves and Walschaert valve gear. With the exception of the increased lap which limits the maximum cut-off to 50 per cent, the arrangement does not differ from the usual Pennsylvania practice.

The use of a 2-in. steam lap necessitates some auxiliary

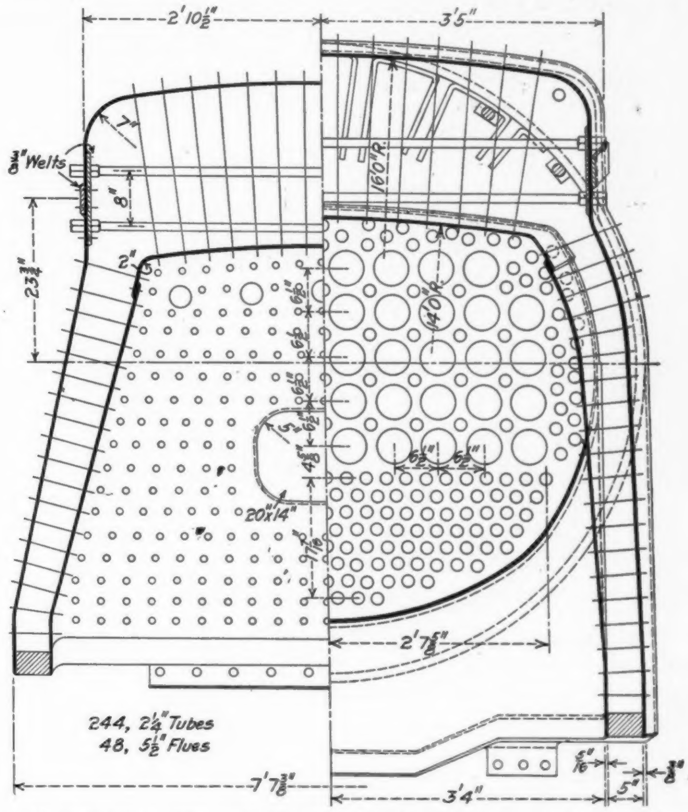


Throttle Valve of the Pennsylvania Decapod Type Locomotive

means of admitting steam to the cylinders when the locomotive is standing in order that it may be started from any position of the crank pins. The means of meeting this requirement is extremely simple. Pockets about 1¾ in. deep are cored out of the inside edge of each steam port in the valve chamber, two in each port located 180 deg. apart.

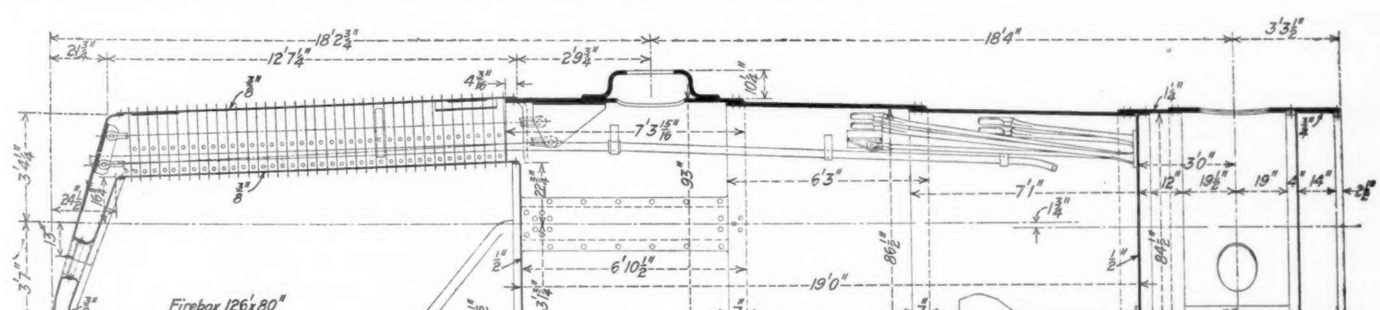
the auxiliary ports are so placed that their steam lap is ¼ in. These ports serve to move the engine only until the main ports are opened.

The purpose of the use of the 50 per cent cut-off is to eliminate the range of cut-offs within which the water rate of the cylinders is excessive, thereby making possible an increase in the ratio of cylinder power to boiler capacity. By



Half Sections Through the Firebox, Showing the Tube Layout

referring to the data for the two classes it will be seen that with but slightly increased boiler capacity an actual tractive effort at 7.2 miles per hour of 80,640 lb. is obtained from the class I-1-s locomotive as compared with a calculated maximum tractive effort of 57,850 lb. for the Mikado type. This is further reflected in the ratio of tractive effort times diameter of drivers to equivalent heating surface. As an indication of the extent to which this increased ratio is justified, it has been found that the tractive effort at 25 miles an hour is 44,400 lb.

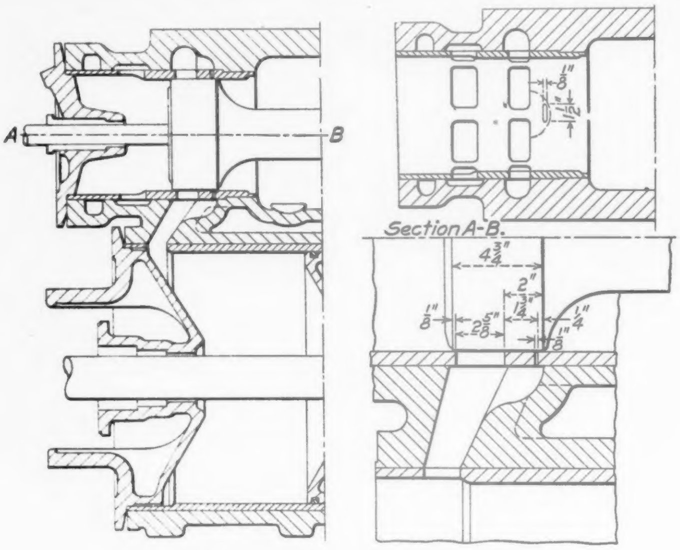


Boiler for the Decapod Locomotive, Which Carries 250 Lb. Working Pressure

Two ports ⅛ in. wide and 1½ in. long are cut through the valve chamber bushing, opening into the pockets in the valve chamber casting. This arrangement is shown clearly in one of the illustrations, from which it will be seen that

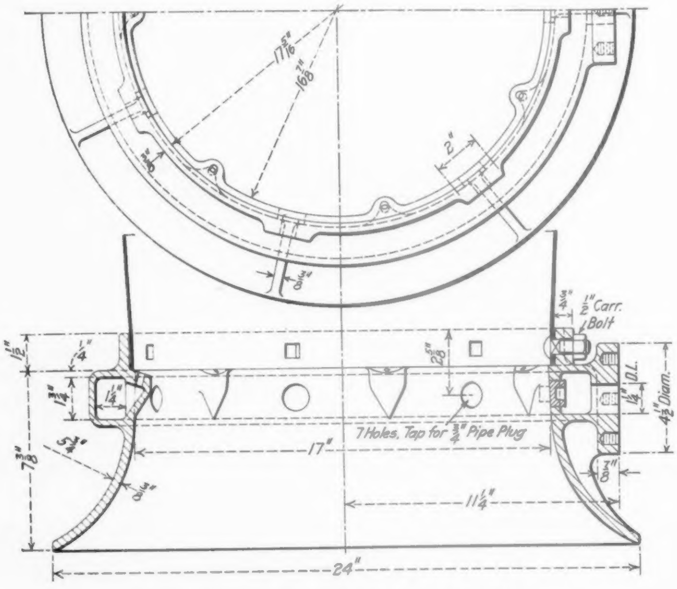
The design of the running gear and reciprocating parts follows very closely that of the Mikado type locomotives. The piston is of rolled steel and is carried on an extension piston rod. The piston rod, driving axles, crank pins,

wrist pins and knuckle pins are all of hollow sections and are heat treated. In order to obtain a proper amount of clearance between the top of the rail and the bottom of the main rod at the rear end, the key bolt was put in from the bottom and this arrangement has been found to be very satisfactory. To obtain clearance between the rear end of the main rod and the side rod knuckle pins the special recessed knuckle pin and depressed nut were used.



Valve Chamber with Auxiliary Starting Ports

The driving wheels are 62 in. in diameter. The front and rear tires are flanged and are 5½ in. wide. The intermediate tires are all flangeless, those of the main wheels being 8½ in. wide, while those of the second and fourth wheels are 7½ in. wide. The locomotive is designed to operate on tracks having a minimum radius of curvature of 350 ft. In the connection between the engine and tender, the old style double safety bars with slotted holes have been replaced with a single safety bar which is of the same



Ring Blower in Base of the Lift Pipe

cross section as the drawbar and ½ in. longer. It is placed immediately under the drawbar, being connected to the engine and tender by the drawbar pins.

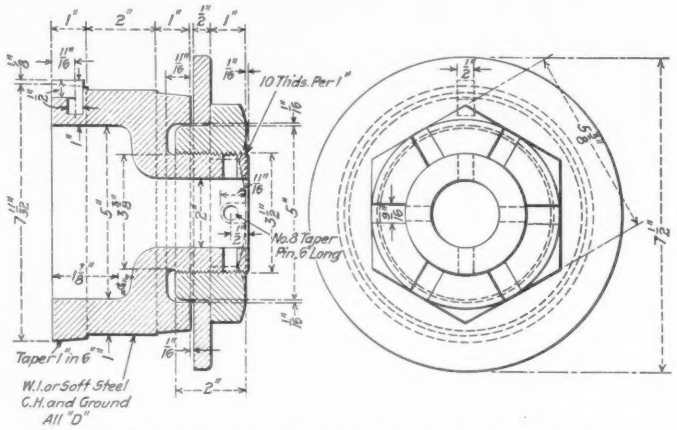
The driver brakes are operated by two 18-in. air cylinders with 13-in. stroke which exert a braking power of 230,000 lb. The arrangement is similar to that described in connection with the class L-1-s Mikados.

In the following table the principal dimensions and data for the Decapod type locomotive are shown in comparison with those for the class L-1-s Mikado type locomotive:

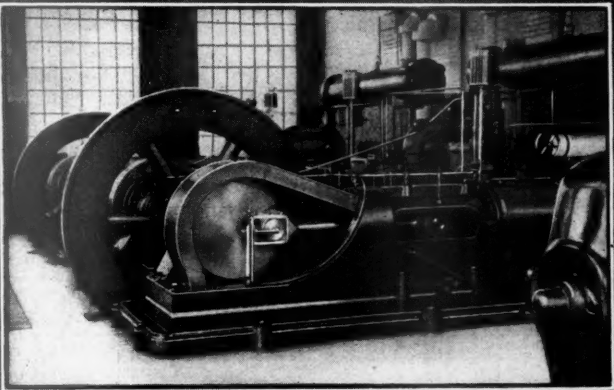
	Decapod Class I-1-s	Mikado Class L-1-s
General Data		
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Freight	Freight
Fuel	Bit. coal	Bit. coal
Tractive effort	80,640 lb.*	57,850 lb.
Weight in working order	366,500 lb.	315,000 lb.
Weight on drivers	334,500 lb.	236,000 lb.
Weight on leading truck	32,000 lb.	27,000 lb.
Weight on trailing truck	....	52,000 lb.
Weight of engine and tender in working order	547,000 lb.	473,000 lb.
Wheel base, driving	22 ft. 8 in.	17 ft. 0½ in.
Wheel base, total	32 ft. 2 in.	36 ft. 5½ in.
Wheel base, engine and tender	73 ft. ½ in.	72 ft. 3 in.
Ratios		
Weight on drivers ÷ tractive effort	4.1	4.1
Total weight ÷ tractive effort	4.5	5.4
Tractive effort × diam. drivers ÷ equivalent heating surface†	786.7	622.0
Equivalent heating surface† ÷ grate area	90.8	82.4
Firebox heating surface ÷ equivalent heating surface,† per cent	4.3	5.1
Weight on drivers ÷ equivalent heating surface†	52.6	40.9
Total weight ÷ equivalent heating surface†	57.7	54.6
Volume equivalent cylinders with 90 per cent max. cutoff	21.4 cu. ft.	19.9 cu. ft.
Equivalent heating surface† ÷ vol. equivalent cylinders	297.0	290.0
Grate area ÷ vol. equivalent cylinders	3.3	3.5
Cylinders		
Kind	Simple	Simple
Diameter and stroke	30 in. by 32 in.	27 in. by 30 in.
Valves		
Kind	Piston	Piston
Diameter	12 in.	12 in.
Greatest travel	6 in.	6 in.
Steam lap	2 in.	⅞ in.
Wheels		
Driving, diameter over tires	62 in.	62 in.
Driving, thickness of tires	....	3½ in.
Driving journals, main, diameter and length	12 in. by 16 in.	11 in. by 15 in.
Driving journals, others, diameter and length	11 in. by 16 in.	....
Engine truck wheels, diameter	33 in.	33 in.
Engine truck, journals	6½ in. by 12 in.	6½ in. by 12 in.
Trailing truck wheels, diameter	....	50 in.
Boiler		
Style	Belpaire	Belpaire
Working pressure	250 lb. per sq. in.	205 lb. per sq. in.
Outside diameter of first ring	84½ in.	78½ in.
Firebox, length and width	126 in. by 80 in.	126 in. by 80 in.
Firebox plates, thickness	....	⅜ in. and 5/16 in.
Firebox, water space	5 in.	5 in.
Tubes, number and outside diameter	244—2¼ in.	237—2¼ in.
Flues, number and outside diameter	48—5½ in.	40—5½ in.
Tubes and flues, length	19 ft.	19 ft.
Heating surface, tubes and flues	4,043 sq. ft.	3,747 sq. ft.
Heating surface, firebox	272 sq. ft.	288 sq. ft.
Heating surface, total	4,315 sq. ft.	4,035 sq. ft.
Superheater heating surface	1,360 sq. ft.	1,159 sq. ft.
Equivalent heating surface†	6,355 sq. ft.	5,766 sq. ft.
Grate area	70 sq. ft.	70 sq. ft.
Tender		
Tank	Water bottom	Water bottom
Weight	182,000 lb.	158,000 lb.
Wheels, diameter	33 in.	36 in.
Journals, diameter and length	6 in. by 11 in.	5½ in. by 10 in.
Water capacity	9,000 gal.	7,000 gal.
Coal capacity	17½ tons	12½ tons

* Actual at 7.2 miles per hour.

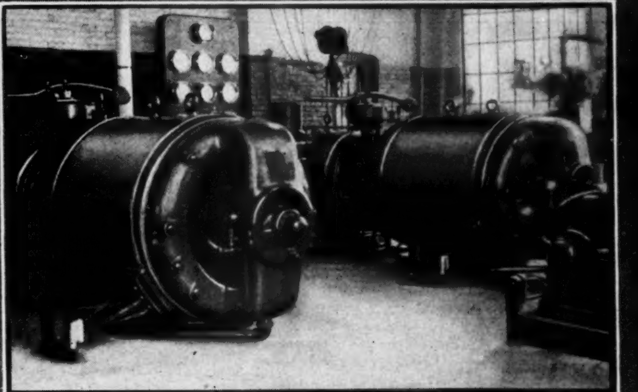
† Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.



Details of the Knuckle Pin with Recess for Depressed Nut



POWER HOUSE ECONOMICS*



BY V. T. KROPIDLOWSKI

MECHANICAL AND ELECTRIC TRANSMISSION LOSSES

TABLE I has been compiled from a report of a test conducted in an eastern locomotive repair shop, having a capacity of about 30 repaired locomotives per month, which may be considered as typical of the majority of railway shops in the country. The test was conducted by representatives of the Westinghouse Electric & Manufacturing Company for the purpose of ascertaining the amount of power used by various tools when operating in regular routine work, and at the same time the power lost by shafting and belting in a group driven system. The machine tools are divided into six groups, the motor for the first group being rated at 40 hp., that for the second being rated at 30 hp., the third at 30 hp., the fourth at 20 hp., the fifth at 10 hp. and the sixth at 40 hp., counting consecutively from left to right in the table. The total horsepower lost from shafting and belt friction was 12 hp., and the average total power developed during the 10-hour day on which the test was conducted was 74 hp. The loss was therefore 16 per cent. This does not include the motor losses, as the results of the test are given in brake horsepower. No one will deny that the efficiency of electric motors is not much over 80 per cent; therefore we find that the shop in question sustains a total power loss, not including the generator and prime mover loss, of 36 per cent. The shaft hangers were all provided with roller bearings.

TABLE I—POWER TO DRIVE LINE AND COUNTER SHAFTS.

	Wheel section	Boiler section	Lathe section	Tool section	Flue section	Smith Shop section
Line shaft	2½"x200'	2½"x170'	2½"x180'	2½"x140'	2½"x90'	2½"x75'
Revolutions of shaft	160	158	155	155	100	100
No. of hangers	26	19	22	20	10	9
No. of countershafts	13	11	22	17	4	10
Power to drive line shaft, countershaft belts off	?	0.3 hp.	0.7 hp.	?	.35 hp.	5 hp.
Power to drive line and countershafts	1.5 hp.	2 hp.	4.1 hp.	2.8 hp.	.6 hp.	1 hp.

Total friction horsepower, not including motor losses = 12 hp.
Average total power developed in 10 hours = 74 hp.
Total power lost = 16 per cent., not including motor losses.

No doubt some reader will consider this unfair to the electric drive because in a group drive there still remains practically the same complement of belting and shafting which is to be found in a mechanically driven shop. That is true, but it must be remembered that in the case of the individual motor drive there are many more motors and they are of a smaller size. Their efficiency is therefore less than that of the large motors used in group drives, and it will be found that the increased electrical losses offset the small gain realized from the reduction in shafting and belt friction. Furthermore, the fixed charges upon the investment will be greater in the case of individual drive, because of the greater first cost of the motors and wiring. This statement is corroborated by the following quotation from an article by Charles H. Benjamin which appeared in the *Engineer* a few years ago: "Experiments made under my direction on several group instalments in machine shops have shown a loss of from 40 to 60 per cent of the total power of the engine before reaching the machine." He says further on: "Direct tests on 16 large machines driven by independent motors in a locomotive works showed an average of 8.85 hp. for the machine and its work, and 2.35 hp. for the power consumed by the motor and countershafting." This means an efficiency of less than 80 per cent for the motors.

An opportunity to determine the loss of power in a purely mechanical drive was afforded by an incident which occurred in a western locomotive shop of about the same capacity as the eastern shop previously referred to. For some reason the boiler pressure went down to six pounds gage and the shop had to be closed for a half day. During this time a roundhouse man came in and wanted a thread cut on a rod bolt. It was decided to attempt to run the shop on the six pounds steam pressure long enough to do the work required. The engine started the entire line shaft and all the countershafts and developed full speed. The line shaft is 310 ft. long, 3 in. in diameter and has 38 babbitted hangers, on the line shaft are mounted 87 pulleys connected to 40 countershafts. The engine driving the shop has 16-in. by 24-in. cylinders and runs at 90 r. p. m. If we allow for a five per cent loss between the boilers and engine and three per cent due to back pressure, the engine cutting off at ¾ stroke, the mean effective pressure on the piston was 5.16 lb. The horsepower developed in driving all the shafting was

$$\frac{5.16 \times 201 \times 2 \times 180}{33{,}000} = 11.4 \text{ hp.}$$

As the average horsepower developed in this shop is approximately 100, the total

*The first of Mr. Kropidlowski's articles on this subject appeared in the May issue on page 243.

loss, including that in the engine, was 11.4 per cent. It might be well to cite another case of direct belt drive. In a New England spinning mill a test was made to ascertain the friction losses, by stopping all of the machines and running only the shafting and belts on idle pulleys. This was found to be 418 hp., the average horsepower developed in the mill being 1,744 and the total loss, including engine losses, 24 per cent. It is a known fact that spinning mills are wasteful of power because of the great number of countershafts required.

POWER PRODUCTION COSTS

There is no reason why the generating equipment in an industrial plant of fair size should not be operated as efficiently as that of the central station, so called. Statistics of different public service commissions uphold this opinion. From a semi-annual report of the New York Edison Company the following data is available:

Total output		120,000,000 kw. hrs.
Total income		$7,231,602.62
Total station expenses	$1,318,570.21	
Distribution expenses	1,210,108.84	
General expenses	704,400.71	
Taxes	402,942.21	
Amortization	916,024.11	
Uncollectible bills	92,860.08	
Total expenses		$4,644,906.16
Total expenses per kw. hr.		3.87 cents
Station expenses per kw. hr.		1.01 "
Average income per kw. hr.		6.02 "

The following cost data is taken from the report of the chief engineer of the Fitchburg Yarn Company:

Average horsepower throughout year		1,744
Coal per horsepower-year 4,229 lb. at $4.50 per ton		$ 8.46
Labor		2.92
Supplies and repairs		1.11
Total operating cost		$12.49
Depreciation and interest	$4.01	
Taxes	0.72	
Insurance	0.04	
Total fixed charges		$ 4.77
Total gross cost		$17.26
Deduct cost of heating		.58
Total cost one hp. per year		$16.68
Cost per hp. hour		0.55 cents
Cost per kw. hour		0.73 cents

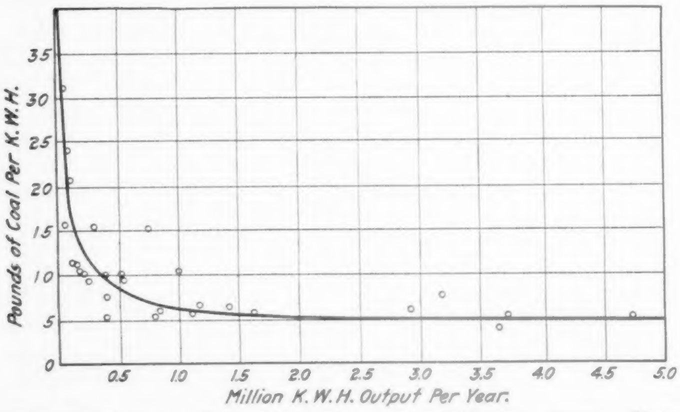


Fig. 1—Average Coal Consumed per Kilowatt Hour, Class "B" Electric Utilities, for the Period from June 30, 1908, to June 30, 1911

This industrial plant is, of course, a very economical plant, nevertheless, the figures present a great contrast with those of the central station just cited. The central station has to contend with greater fixed and general expenses. For instance, from a report of the Public Service Commission of the state of New York, a large central station in New York City is shown as having an operating expense of but 26½ per cent of the total cost of production, the remaining 73½ per cent being made up of overhead and distribution charges. This same company is capitalized at over $440 per kilowatt of rated capacity, where a fair sized industrial plant can usually be installed for from $65 to $100 per kilowatt of capacity.

By referring to Fig. 1, which is taken from the Wisconsin Railroad Commission's report for the year 1914, it will be seen that a plant of 1,000,000 kw. hrs. output per year, which is equivalent to approximately 300 kw. installed capacity, is practically as economical in fuel consumption as the plant producing 4,500,000 kw. hrs. per year. This indicates that within certain limits there is not much variation in the efficiency of the machinery and personnel of a large or small plant.

RATES AND COST OF PRODUCTION

The question is often asked how some of the public utilities are able to sell electricity in bulk for less than it costs to produce it, as they evidently must, in some cases, if

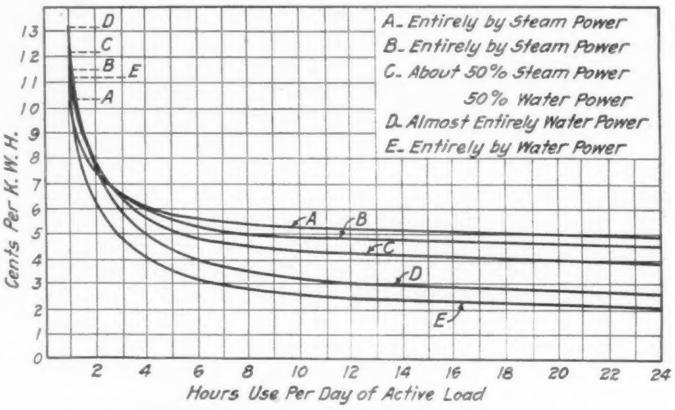


Fig. 2—Cost Curves for Commercial Electric Lighting

they sell it for 1½ cents per kw. hr. The answer is that the maximum rate customers make up the deficit.

The writer once overhead a conversation between two men, one complaining regarding the cost of light in his house, the other evidently an officer of one of the large power producing companies. The latter told the complainant that his company did not care for the small users, as they cost more than they return and that the profit was made from the big users of power; those paying the low rate. An examination of the conditions seems to refute this. By referring to Fig. 3 it will be seen that if a company has a 12-cent maximum rate, and if the maximum rate customers comprise 10 per cent of the total patronage and if the company's production costs are such as to require an income of 5.95 cents per kw. hr. for a profit, the remainder of the customers will have to pay 5.3 cents per kw. hr. If 40 per cent of the power was sold at 12 cents, the remaining 60 per cent would need to pay but two cents. Again, if the maximum rate is 15 cents per kw. hr. and 40 per cent of the customers paid that rate, the remaining 60 per cent would need to pay the small sum of but ½ cent per kw. hr. to make up the necessary average income of 5.95 cents per kw. hr.

This shows conclusively that the small consumers, or those paying the maximum rate, were the ones most desired. To bring out this fact still more forcibly, Table II has been compiled from the report of the Wisconsin Railroad Commission for 1914, referring to a certain large power producing concern in that state. It will be noted that the company in question sustained a loss of 1.49 cents per kw. hr., as shown in column (2), which is due to the heavy fixed charge of 1.86 cents per kw. hr. According to this statement, it would seem that the company could not exist and it could not if it were not for the fact that all the company's lighting business is outside of the state of Wisconsin, while, of course, the Wisconsin commission only accounts for the business done in that state. Table III shows that 94.25 per cent of the company's business in the state of Wisconsin is bulk sales to other utilities. It further will be noted by referring to Table II, column (1),

that the fixed charges, including depreciation, taxes and interest on funded debt amount to 172.10 per cent of the operating revenue, the interest on funded debt alone amounting to 139.89 per cent, which shows that the company is highly capitalized.

TABLE II—ANALYSIS OF REVENUES AND EXPENSES OF A WISCONSIN POWER COMPANY.

	Analysis of Income Account, Per Cent	Analysis of Income Per. Kw. Hr. Sold, Cents	Analysis of Different Classes of Expense, Per Cent
Operating revenue	100.00	1.33	....
Operating and maintenance expense..	42.06	.56	19.05
Depreciation	10.00	.13	4.67
Taxes	22.23	.30	10.38
Interest on funded debt and mortgages	139.87	1.86	65.30
Non-operating revenue	1.96	.03	....
Deficit	112.20	1.49	....
		Total expense	100.00

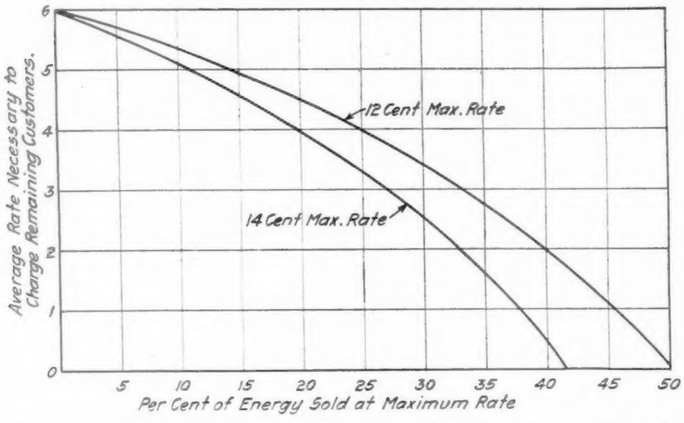


Fig. 3—Average Minimum Rates at Which Power Can be Sold to Large Users

TABLE III—PERCENTAGE ANALYSIS OF SOURCES OF REVENUE OF THE COMPANY REFERRED TO IN TABLE II.

Commercial lighting	3.41 per cent
Municipal lighting	.92 per cent
Commercial power	1.22 per cent
Bulk sales to other utilities	94.25 per cent
Miscellaneous earnings	.20 per cent
Total operating revenue	100.00 per cent

Fig. 2 has also been taken from the Wisconsin commission's report and shows cost of generation of all the electric companies operating in Wisconsin, at various load factors. It shows the lowest cost to be two cents at 100 per cent load factor. This condition, however, is not attained by any company, 75 per cent being exceptional and the average being 30 per cent.

EXHAUST STEAM HEATING

The diagram in Fig. 4 has been constructed from data obtained by a company engaged in the steam heating business. This diagram enables one to tell at a glance the percentage increase in coal consumption per hp. hr. resulting from various increases in back pressure. It will be seen that at five pounds back pressure, which is the most that need be carried on any well laid out heating system of moderate size, the increased coal consumption per hp. hr. equals 10 per cent. If an engine consumes 34 lb. of steam per hp. hr. and 90 per cent of that steam is available for heating after passing through the engine, 30.6 lb. of steam per hp. hr. will be available for heating. If a horsepower is produced on five pounds of coal with no back pressure, with five pounds back pressure it will require ½ lb. more coal per hour. Each square foot of radiating surface will require 0.3 lb. of steam per hour under ordinary conditions. Each horsepower developed will therefore take care of 30.6 ÷0.3, or 102 sq. ft. of radiating surface. As each hp. hr. requires ½ lb. additional coal due to the back pressure, each square foot of radiating surface will be chargeable with 0.5÷102=.005 lb. of coal per hr. Therefore, if a shop requires 6,000 sq. ft. of radiating surface and the required amount of exhaust steam is available 24 hrs. a day for 30 days a month, the shop will be heated with

$$\frac{6{,}000 \times .005 \times 24 \times 30}{2{,}000} = 10.8$$

tons of coal per month. If that amount of radiation can be supplied with 20 times 10.8 tons of coal applied directly to the heating system it will indicate an exceptionally good performance. Of course, the above figures are based on the assumption that exhaust steam is available continuously, a condition which seldom exists in practice. As far as the exhaust steam is available, however, these results may be obtained, and it is evident that the claim that the back pressure imposed on the engine by the steam heat system neutralizes the saving from the use of the exhaust steam, is entirely unjustified.

TRANSMISSION OF STEAM AND ELECTRICITY

There has not been much discussion on the comparative cost of steam and electric transmission, probably due to the fact that the advantages of electricity over steam when conveyed any appreciable distance is so evident that it needs no discussion. There are many cases, however, where steam is conveyed for distances of several hundred feet to isolated power units about the shop, and it may be worth while to arrive at the relation of the two systems of transmission under such conditions. Supposing we have an engine developing an average of 25 hp. at a distance from the source of steam supply of 500 ft., which is not an uncommon condition. For this distance a 3-in. pipe will be required, having a radiating surface of approximately 500 sq. ft. According to George H. Banns' experiments, at 150-lb. steam pressure this pipe will condense, if not insulated, 1.16 lb. of steam per sq. ft. of surface per hour, or 580 lb. of steam per hour. If the engine uses 40 lb. of steam per hp. hr. the loss will be $\frac{580}{25 \times 40}$=58 per cent. Usually, however, high pressure steam pipes are insulated, and in this case, with the very best pipe covering the condensation would be reduced about 75 per cent, bringing the loss down to 14.5 per cent. If an electric motor were used under the same conditions there would be a line drop of about three per cent. Furthermore, 500 ft. of 3-in. pipe, not including fixtures or labor for installing, will cost about $121. A 500-ft. three-phase electric line, for the wire alone, will cost about $86. Furthermore, electric motors are much more economical than small steam engines.

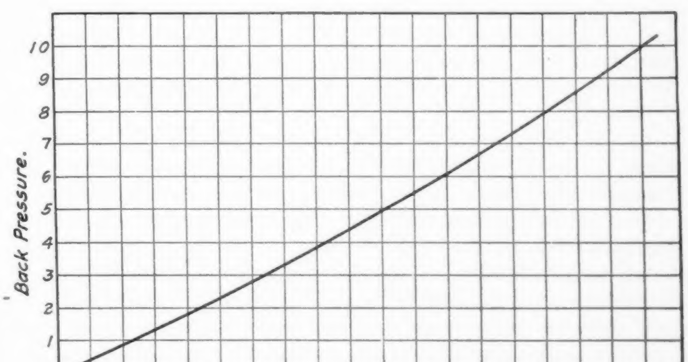
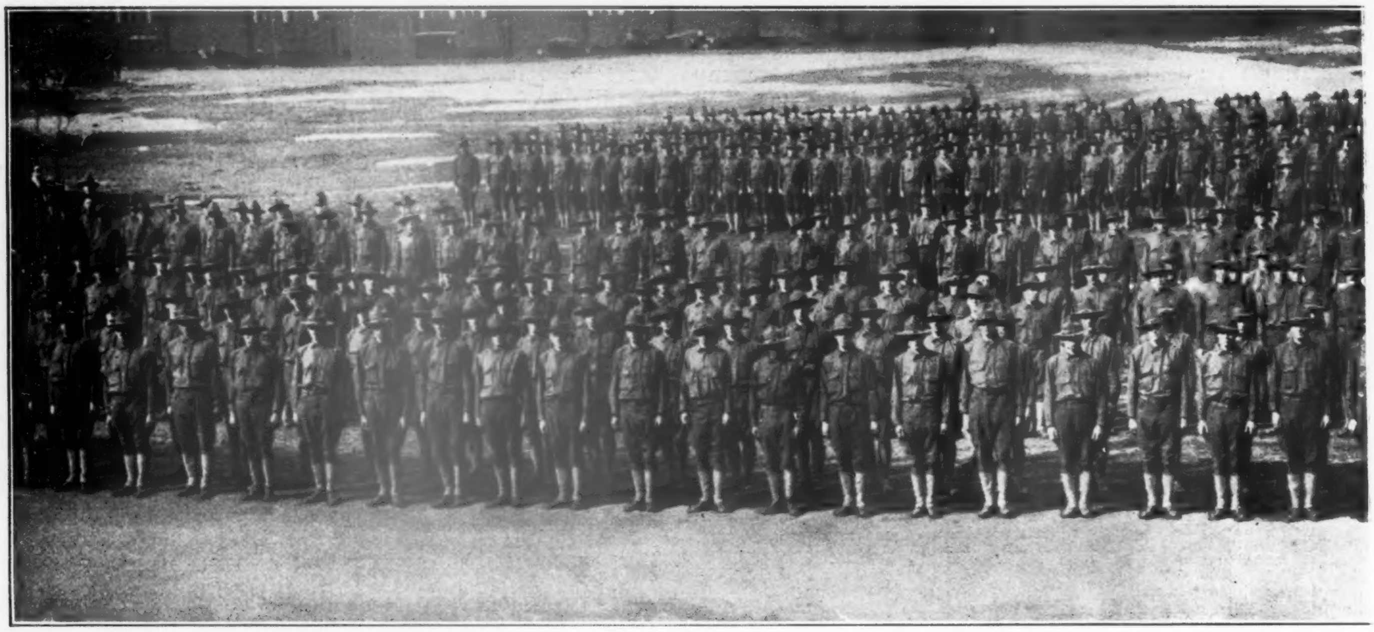


Fig. 4—Calculated Additional Fuel Consumption Due to Back Pressure from Heating System, Based on 45 lb. M.E.P.



The Ninth Engineers on Parade

THE NINTH REGIMENT OF ENGINEERS

The Railway Shop Regiment Now in Camp at Philadelphia Awaits Orders to Sail for France

BY OUR SPECIAL MILITARY OBSERVER

THE Ninth Engineers of the National Army mobilizing to full war strength are now in camp in the Commercial Museum at Philadelphia nearly 1,200 strong. They are putting on the finishing touches preparatory to their starting for France in the near future to help the French repair and maintain locomotives for use behind the front. The men are picked men from the locomotive repair forces of many of the railway shops between New York, Philadelphia, Baltimore and Pittsburgh. They are under the command of a regular army colonel and of majors, captains and lieutenants who were formerly mechanical department officers and nearly all of whom are college men and have had a month or more of intensive military training at Plattsburg or Fort Niagara.

About the middle of May, W. W. Atterbury, vice-president of the Pennsylvania Railroad, received a request from Samuel M. Felton to assist in the raising of a regiment of shop men for service in France. Mr. Atterbury promptly assigned to this work James Milliken, special engineer, and formerly superintendent of motive power of the Pennsylvania at Wilmington. Mr. Milliken and his staff entered upon the new duties with a snap and vim, and results began to come in promptly. First, they took three typical shops on the Pennsylvania system, averaged the number of blacksmiths, boiler shop, erecting shop and machine shop employees, etc., and reduced the figures to the basis of 1,000 men. Then they got in touch with the Bureau of Railway Economics at Washington, and obtained the number of motive power employees on each of the roads in the Eastern territory. With this as a basis they assigned a quota to each road in the territory and asked for double that number, so as to take care of rejections of one kind and another.

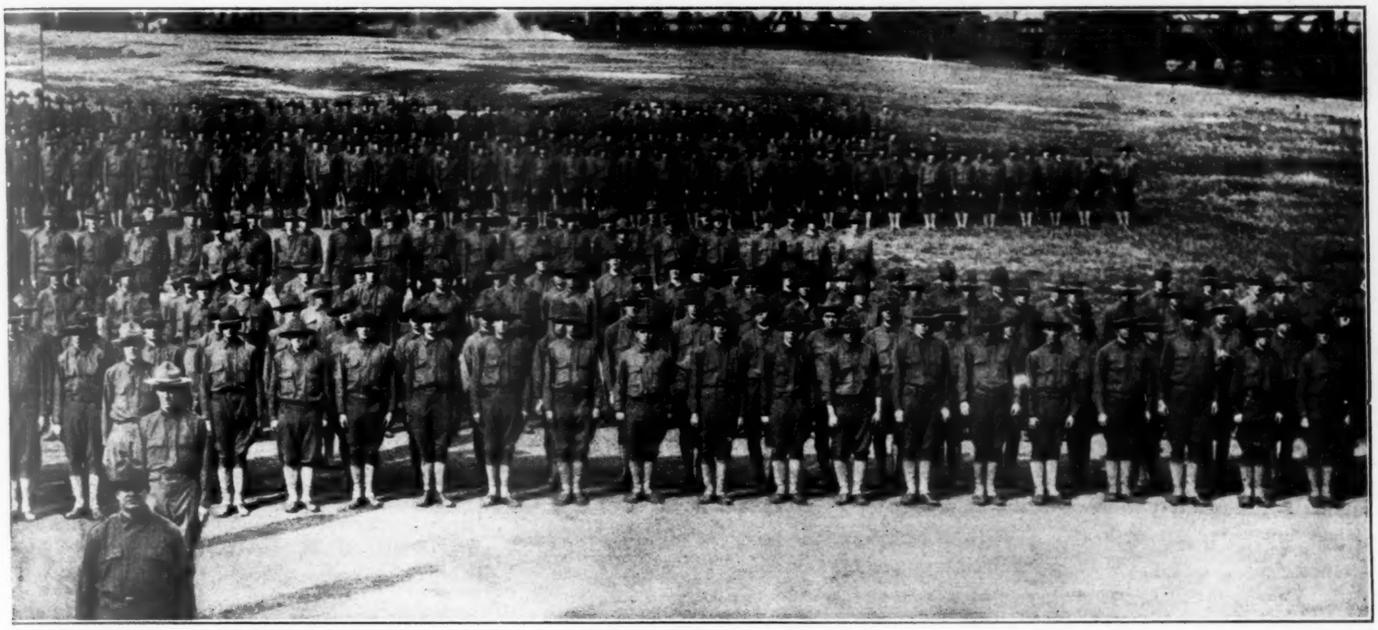
Mr. Milliken himself took charge of the recruiting on the Pennsylvania, and with such effectiveness that the road raised 40 per cent of the regiment instead of its assigned 30 per cent. First, he called a meeting of the general superintendents, and told them that each division had been assigned to raise a certain number of blacksmiths, boiler makers, etc. He told them to emphasize in calling for volunteers that the men were to go to France to repair locomotives, that while as soldiers they might be called upon to work hard, they would still be engaged on work with which they were familiar, and that they would not be called upon to go into the trenches as infantry. The superintendents fell in with the idea at once. The very next day no less than 76 men reported from Trenton; faster than the examiners could take care of them. The entire quota of 30 per cent was filled in 10 days, or before June 1. By June 20 the entire regiment of 1,098 officers and men was complete, and the officers had been selected. The regiment has since been asked to raise an additional 10 per cent of enlisted men—104 more. It still lacks some of these, particularly blacksmiths and boiler makers.

Each man as he presented himself was given a careful physical examination and was quizzed as to his qualifications by William A. Herbert, assistant enginehouse foreman at West Philadelphia. The regiment consists of an exceptionally fine body of clean-minded and physically fit men, every one of which has a trade and a desire to do big things. The officers are 100 per cent enthusiastic over them.

It is interesting to see what kind of skilled mechanics were secured. The following list will show how the trades are divided:

STATEMENT SHOWING BY TRADES THE MAKE-UP OF THE LOCOMOTIVE SHOP REGIMENT.

COMMANDING OFFICERS		37
MEDICAL MEN		23
MASTER MECHANICS AND SHOP OFFICERS		120
Storeroom attendants	18	
Draftsmen	11	
Stenographers	20	
Shop clerks	6	
Storeroom clerks	5	
Clerks	58	
Telegraph operators	2	
	120	



BLACKSMITH SHOP		126
Blacksmiths	43	
Forgemen	4	
Spring makers	8	
Tool dressers	8	
Furnace heaters	4	
Forging machine men	10	
Steam hammer operators	5	
Blacksmith helpers	44	
	126	
BOILER SHOP		128
General boilermakers	39	
Flangers	4	
Layout table and template men	4	
Flue men	17	
Riveters	16	
Boilermaker helpers	35	
Boiler shop machinists	13	
	128	
ERECTING SHOP		163
General erecting shop men	24	
Valve setters	13	
Cylinder and guide men	8	
Driving box men	8	
Spring rigging men	8	
Truck men	16	
Frame men	7	
Cab fitters	8	
Throttle and dry pipe men	8	
Air brake men	16	
Grate and ash pan men	8	
Erecting shop helpers	32	
Crane operators	7	
	163	
MACHINE SHOP		162
General machine shop hands	24	
Engine lathe hands	16	
Turret lathe hands	16	
Axle lathe hands	4	
Boring mill hands	10	
Milling machine hands	8	
Shaper hands	6	
Planer hands	6	
Slotter hands	5	
Drill press hands	9	
Tool makers	10	
Vise hands	27	
Air pump men	8	
Triple valve men	8	
Injector repairers	5	
	162	
TENDER AND CAR REPAIRMEN		40
Cistern repairmen	8	
Truck repairmen	16	
Locomotive cab builders	6	
Cabinet makers	2	
General wood woikers	4	
Wood work machine hands	4	
	40	
PIPE SHOP		58
Pipe fitters	17	
Plumbers	4	
Coppersmiths	5	
Copper and brass braziers	5	
Pipe fitter helpers	22	
Coppersmith helpers	5	
	58	
ELECTRICIANS		28
General electricians	5	
Linemen	4	
Battery men	2	
Electrician helpers	3	
Stationary engineers	5	
Stationary firemen	5	
Derrick engineers	4	
	28	
TIN SHOP		20
Tinsmiths	4	
Lamp makeis	4	
Sheet iron workers	8	
Tin shop helpers	4	
	20	
PAINT SHOP		11
Locomotive painters	7	
Stripers and letterers	4	
	11	
CHAUFFEURS		38
Chauffeurs	30	
Auto. engine men	4	
Auto. electrical men	4	
	38	
MISCELLANEOUS		144
Laborers	89	
Locomotive hostlers	2	
Brick layer	1	
Rigger	1	
Chemist	1	
Cooks	27	
Buglers	13	
Barbers	6	
Tailors	2	
Photographers	2	
	144	
Grand Total		1,098

The men in the regiment serve with the same ranks and pay as if they were in the Regular Army. The corporals, as a rule, were gang leaders, the sergeants, gang foremen and commissioned officers, motive power department officers.

The men were divided among the six companies as they reported, but by the time this will have appeared in print they will have been rearranged in so far as possible by trades. The assignment of companies, divisions of work and officers will then be as follows:

Colonel, Herbert D. Deakyne; lieutenant-colonel, H. H. Maxfield, superintendent, motive power of the Pennsylvania Railroad, at New York; captain, adjutant, William F. Tompkins, a West Point man; captain, quartermaster, C. R. Rogers, a contractor from Corry, Pa.; captain engineer, Van R. C. King, district superintendent, Atlantic Coast Line, Wilmington, N. C.

First Battalion—Major, Charles D. Barret, master mechanic, Pennsylvania Railroad, Sunbury, Pa.

Company A—Erecting shop and enginehouse—Captain, J. McDonough, assistant shop superintendent, Baltimore & Ohio, Baltimore, Md.; first lieutenants, F. V. DeHaven, Pennsylvania Lines, West, and C. K. Steins, special ap-

prentice, Pennsylvania; second lieutenant, Don C. Minick, Pennsylvania Lines West.

Company B—Tender, cab and tank shop—Captain, G. T. Huff, Jr., assistant road foreman, Pennsylvania; first lieutenants, R. R. Meigs, a consulting engineer, at Philadelphia, and W. H. Stevens, also a consulting engineer, from Philadelphia; second lieutenant, McClure Fahnestock, motive power inspector, Pennsylvania, at Pittsburgh.

Company C—Boiler shop—Captain, G. W. Butts; first lieutenants, F. R. Fitzpatrick, Locomotive Superheater Company, New York, and T. L. Mallam, boiler shop foreman, Pennsylvania, Trenton, N. J.; second lieutenant, E. D. Hagerty, storekeeper, Pennsylvania, at Verona.

Second Battalion—Major, C. S. Gaskill, master mechanic, Pennsylvania, Baltimore, Md.

Company D—Machine shop—Captain, F. S. Robbins, assistant master mechanic, Pennsylvania, Pittsburgh, Pa.; first lieutenants, J. J. McGuire, master mechanic, Baltimore & Ohio, at Newcastle, and C. G. Boffemmyer, test department, Pennsylvania, Altoona; second lieutenant, A. G. Moler, Philadelphia.

Company E—Electricians (power plants) and shop construction—Captain, B. W. Kline, electrician, Pennsylvania, Williamsport; first lieutenants, Alba B. Johnson, Jr., Baldwin Locomotive Works, and William Welch, blacksmith shop foreman, Pennsylvania, Meadow Shops; second lieutenant, Charles G. Brown, Altoona shops.

Company F—Pipe and tin shop—Captain, E. B. Whitman, assistant road foreman, Pennsylvania, Pittsburgh; first lieutenants, W. B. Rudd, assistant road foreman, Pennsylvania, Jersey City, and F. A. Wightman, motive power inspector, Pennsylvania, New York; second lieutenant, J. G. Shaeffer, special apprentice, Pennsylvania, Altoona.

The men are now quartered in the big hall of the Commercial Museum, with accommodations, incidentally, that would make a fellow who had been to Plattsburg or to the border, green with envy. They have shower baths with hot and cold water—over 60 of them—and with 30 real Ruud heaters. They drill on Franklin Field or on a big parade ground outside the museum, and when drill is over, have a chance at the swimming pool on the university grounds.

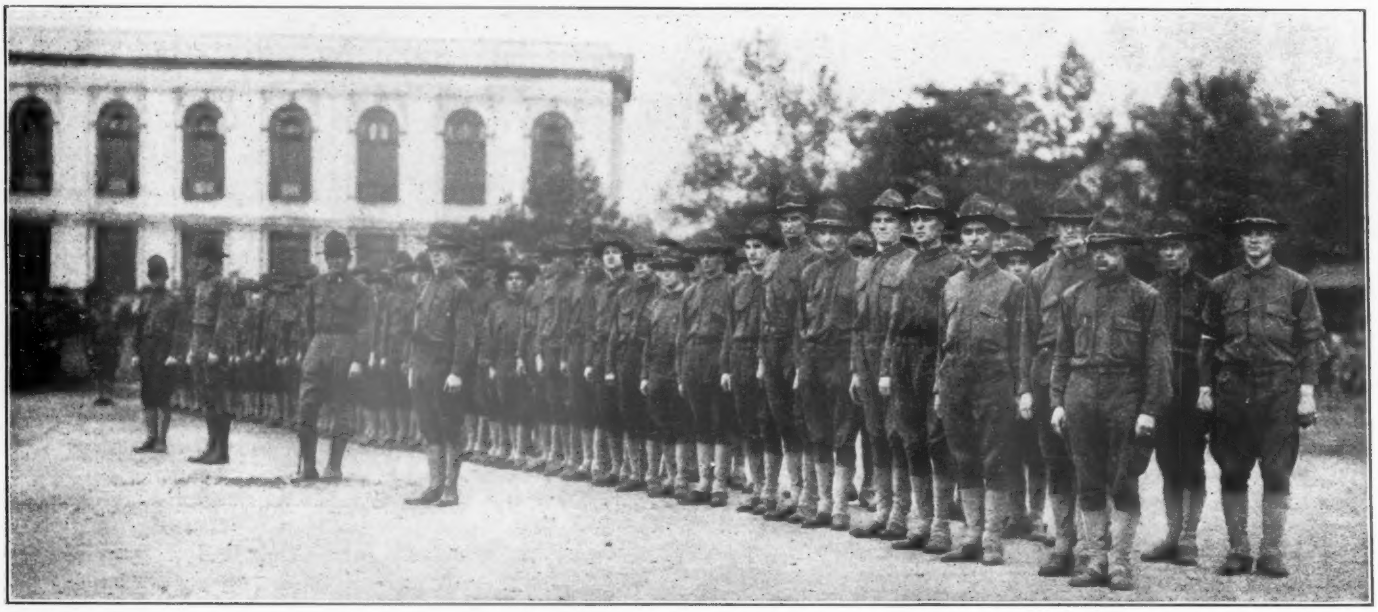
The men drill for four drill periods of an hour, daily. They already march like fit soldiers. Our observer knows, he saw one of the companies doing it on Franklin Field. The men have only one kick. That's about the typhoid inoculations: Three paratyphoid, three typhoid and a smallpox vaccination. Some of the men keel over; some have arms as sore as boils, and the inoculations aren't over yet.

Y. M. C. A. WORK

No military camp could ever be complete in these modern times without its Y. M. C. A. The camp of the Ninth Engineers is no exception. The moment the Commercial Museum was occupied, the Pennsylvania Railroad Y. M. C. A. brought in writing tables, chairs, pens, ink and stationery, and started work. It has printed special letterheads, and envelopes marked "Correspondence Table, Ninth Regiment Engineers." It has brought in a piano, a victrola, magazines and books, and its efforts have been duly repaid.

William A. Patton, assistant to President Rea, is in general charge of the work, and J. Frank Keehler is the man-on-the-job. They have arranged entertainments once or twice a week, and now and again they have secured a speaker, who talks to the boys on questions of interest. Realizing that Americans are not strong, linguistically, they have secured five French instructors, and the boys have been given an opportunity to learn the language free of charge.

The Pennsylvania Railroad Women's Division for War Relief will supply each member of the regiment with a comfort kit, and some of these have already been sent to the regiment from all sources.



Some of the Pennsylvania Railroad Men in the Ninth Regiment

THE BAND

And the Pennsylvania Railroad furnished the instruments for a band—a 31-piece band, that was able to play "The Star-Spangled Banner" three days after they got the men together. The band is pretty strong on many other patriotic tunes by this time, and there is a rumor—it's only a rumor—that the regiment is going to have a special song, presumably for the band to play, and that its composers are going to be Irving Berlin and George M. Cohan. But more of that when we hear the words and music.

But to be serious again, the regiment is looking forward to some good hard work across the sea. Just where it will go—that is, to what French railway shops—the men don't know as yet, and if they did, they wouldn't tell anyway. But they are prepared for anything. They will carry many of their own tools; they also have 12 Pierce-Arrow trucks.

The Pennsylvania Railroad is proud of the regiment; and it has a good right to be. Mr. Atterbury, particularly, is taking a keen interest in its success. He has visited the regiment on a number of occasions and has expressed the hope that he may present the regiment with its colors.

Pennsylvania Electric Locomotive

Experimental Design for Heavy Trunk Line Service to Operate Over 24 Miles of One Per Cent Grade

THE Pennsylvania has designed and built an experimental electric locomotive which is to be used ultimately to handle tonnage trains over the grade west of Altoona, Pa. This section includes the Horseshoe Curve and consists of a 2 per cent grade 12 miles long between Altoona and Gallitzin, the summit of the grade, on the eastern slope, and a one per cent grade 24 miles long from Gallitzin to Johnstown, Pa., on the western slope. This locomotive was built for the purpose of carefully developing a standard unit before going ahead with the production of the number of units required. In general the locomotive is somewhat similar to those used on the Elkhorn Grade electrification of the Norfolk & Western in that it uses three-phase motors, fed by a phase-converter connected to an 11,000-volt single-phase contact wire, it also uses the principle of transmitting the motor power to the drivers through regular standard side rods connected to a motor driven jack shaft.

Many of the important details, however, in the new locomotive are distinct departures from any previous design. The most unique feature of the locomotive is that instead of being made up of two cabs like those on the Norfolk & Western and the St. Paul, it consists of only one cab which rides on two articulated six-wheel driving trucks.

The locomotive is to be given a preliminary trial on the Philadelphia-Paoli 11,000-volt electrification of the Pennsylvania.

The locomotive is designed to operate on 11,000 volts, single-phase, 25-cycle current taken from an overhead contact wire. The current is supplied to the primary of a static transformer which returns it to the track circuit and in so doing excites the secondary of the transformer from which the phase converter is operated. This phase converter changes the single phase current supplied to it by the transformer to three-phase current for the use of the traction motors. These motors, of which there are four, have a rating of 1,200 hp. each, giving the locomotive a capacity of 4,800 hp.

The three-phase current taken from the phase converter is supplied, through the necessary control switches, to the primaries of these motors and the secondary current thus generated in the other windings of the motors is controlled by the motorman by means of water rheostats, thus permitting very close regulation of the tractive effort developed by the locomotive during acceleration.

The two motors which are mounted on each truck frame are geared to a jack shaft driving the driving wheels through connecting rods and the springs in the gears of these jack shafts are so adjusted as to give the effect of a solid gear up to a tractive effort equivalent to 25 per cent of the weight on drivers. Therefore, under all ordinary conditions the effect of a solid gear is obtained.

The locomotive has two operating speeds with possibilities of operating at any intermediate speed from zero to the maximum, by means of the rheostatic connections. The lowest of these speeds is 10.3 m. p. h. and is obtained by connecting the motors on either truck in cascade with each other and in parallel with those on the other truck. It is contemplated to use this speed only in slow movements and around yards. The other speed of 20.6 m. p. h. is obtained by connecting the motors on both trucks in parallel and this is the speed at which the locomotive is designed to operate in

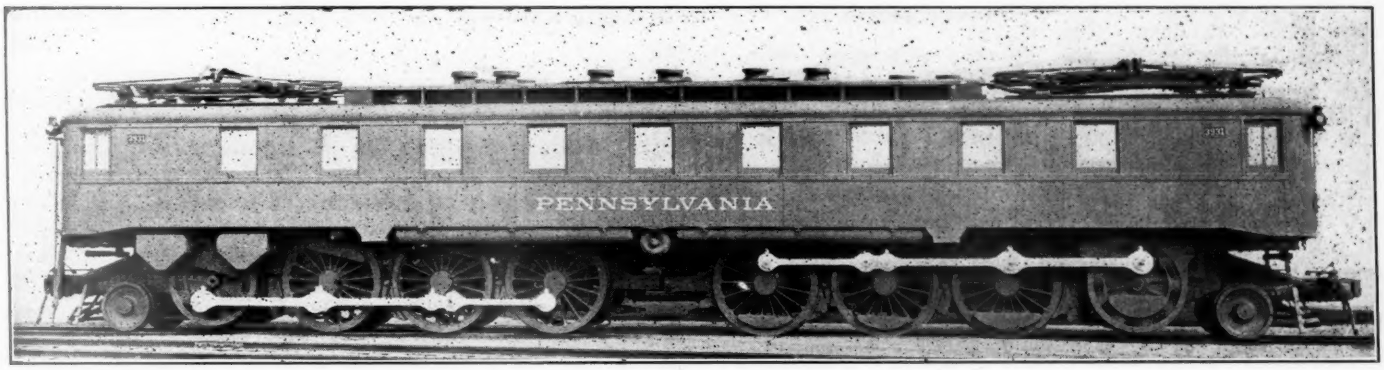


Fig. 1—Pennsylvania Electric Locomotive for Heavy Trunk Line Service on Two and One Percent Grades

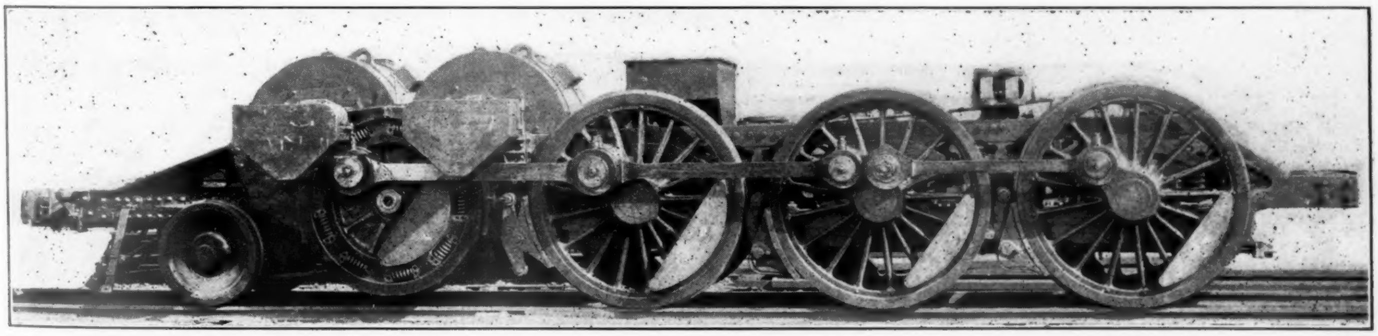


Fig. 2—One of the Driving Trucks for the Pennsylvania Electric Locomotive Showing Motor and Spring Gear Jack Shaft

road service and at which it gives a tractive effort of 87,200 lb.

The cab containing the electrical machinery is 72 ft. 6 in. long and 10 ft. wide over sheathing. It has two Z-shaped center girders 26 in. deep, made of plates and angles covered on top with a plate 6 ft. 1⅛ in. wide, which forms the platform floor to which the electrical machinery is attached. The side framing is of the same type as on Pennsylvania passenger cars, consisting of U-shaped posts bent at the top to support the lower roof deck and sheathed with ⅛-in. plates. The upper deck extends only over the central part of the cab for a length of 36 ft. 9 in., leaving a space at each end of cab for the pantagraphs.

To permit removal and replacing of electrical machinery the roof of the upper deck is removable and the turtle back decks at each end of cab are equipped with large hatches. No lining is provided for the body of the cab, but the motorman's ends, which are separated from the main cab by partitions, are lined and insulated and provided with a resilient floor covering. For the protection of the motorman the ends of the cab are also provided with strong vertical members, similar to those used in Pennsylvania steel passenger and postal cars. Both sides for the full length of the upper deck are made in the form of louvres to provide for ventilation.

Each truck is a motor truck, which receives power from two motors through a spring wheel on each side, mounted on a jack shaft. Each gear wheel is connected to the three drivers by the usual side rods and the remainder of the drive and running gear is similar to those used for steam locomotives. The spring gear for each truck is of the three point suspension type, one point being over the pony truck and the other two points over each frame, consisting of equalizers over each box, elliptical springs between journals and helical springs outside of the first and third journals.

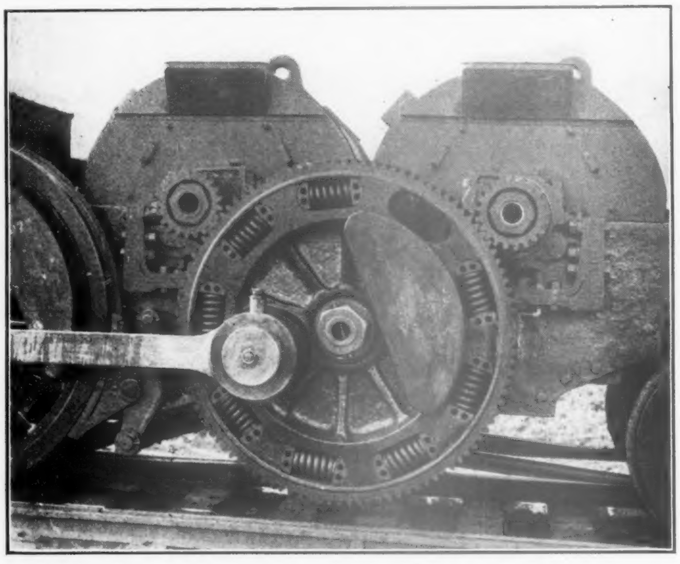


Fig. 3—A View of the Jack Shaft With Its Spring Gear

Brake shoes are provided for one side of each driver, the brake arrangement being of the usual steam locomotive type with two cylinders, each 16 in. in diameter and located between the frames between the second and third axles. The train brake and locomotive brake can each be operated independent of the other. Above the frames and between the first pair of drivers is located a sand box with sand pipes leading to the front of the first pair of drivers and to the rear of the third pair of drivers, and equipped with Leach double "E" sanders. The gear wheels have inward projections forming the jack shaft journals. The bearings therefore are solid bronze forced into a circular opening in the frame casting.

The center plate is located halfway between the first and second axles at an elevation of about the height of the top of the frames. Between the second and third axles an auxiliary spring support has been applied for the purpose of equalizing the loads on the various drivers, which will counterbalance the excess weight due to the location of motors between the pony truck and the first pair of drivers. The contact between the caps over these springs and the bottom surface of the cab must necessarily be a sliding contact.

Each motor truck includes a pony truck of the Pennsylvania Railroad type, with an elliptic spring located each side of the axle and supported on T-links. As the usual T-links alone will not provide sufficient lateral motion, a rocker casting supported by the elliptic springs has been added. The combination T-links and rocker permit sufficient lateral motion for curves of 275 ft. radius. The articulation between the motor trucks is of a construction similar to a pedestal attached to the cab center sills. The lower ends of the pedestal legs are connected together with a tie bar. This permits each truck to rotate around the center of the center plate without restriction. All bearing surfaces in the articulation are plated with manganese steel. The pulling and pushing strains between drawbars carry through the trucks and articulation in a direct plane 34½ in. above the rails so that the cab is entirely relieved of these strains.

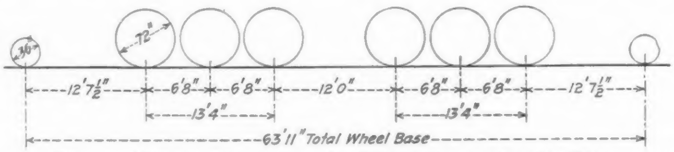


Fig. 4—Wheel Arrangement of the Pennsylvania Electric Locomotive

The principal characteristics of the locomotive follows:

Railroad classification	FFI
Overall length	76 ft. 6¼ in.
Total wheelbase	63 ft. 11 in.
Driving wheelbase	38 ft. 8 in.
Rigid wheelbase	13 ft. 4 in.
Height from rail to locked position of pantagraph	15 ft. 6 in.
Height from rail to top of cab	14 ft. 8 in.
Width over cab body	10 ft. 0 in.
Overall width	10 ft. 1 in.
Diameter of driving wheels	72 in.
Diameter of pony wheels	36 in.
Weight on drivers	198 tons
Number of driving axles	6
Weight of each pony truck	21 tons
Total weight of locomotive	240 tons
Voltage of locomotive	11,000
Tractive effort at hourly rating of motors	87,200 lb.
Speed	20.6 m.p.h.
Capacity of locomotive—one-hour rating	4,800 h.p.

CARS AND LOCOMOTIVES ORDERED IN JUNE

Although June is usually a comparatively quiet month from the standpoint of equipment purchases, the purchases in June this year held up exceedingly well. The domestic purchases of locomotives were not large, but there were important purchases by foreign roads. The purchases of freight cars, however, were considerably larger than in the months immediately preceding. The purchases were as follows:

	Locomotives	Freight cars	Passenger cars
Domestic	64	11,945	2
Foreign	443	100	..

Among the important locomotive orders were the following:

Chicago & Alton	10	Mikado	Baldwin
Southern	25	Santa Fe	American
Russian Government	400	Narrow Gage	Americna

The important freight car purchases included the following:

Atchison, Topeka & Santa Fe	500	Gondola	Am. C. & F.
Canadian Government Railways	5,000		Can. C. & F.
Illinois Central	75	Caboose	Co. shops
	250	Box	Co. shops
	250	Stock	Co. shops
Marianna Coal Co.	1,000	Coal	Cambria
Missouri Pacific	500	Box	Co. shops
Norfolk & Western	2,000	Box	Co. shops
Pennsylvania	1,000	Box	Co. shops

New Power for Southern Railway

4-8-2 Type Weighs 314,800 lb., 2-10-2 Type 370,600 lb., Tractive Efforts 47,800 and 71,000 lb., Respectively

THE Southern Railway and its associated lines are now receiving from The Baldwin Locomotive Works 30 locomotives of the Mountain type for passenger service, and 55 locomotives of the Santa Fe type for freight service. These locomotives considerably exceed in weight and hauling capacity the designs heretofore used on this road, and they constitute a notable group of modern heavy power.

Of the Mountain type locomotives, 23 are for the Southern Railway proper, while five are assigned to the Cincinnati, New Orleans and Texas Pacific, and two to the Alabama Great Southern. These engines replace Pacific type locomotives, a comparison of the two types being as shown in the table.

The figures clearly indicate the increased capacity of the new engines, which are able to handle heavy trains on schedule without forcing the maximum speeds above reasonable limits. This means added safety in operation, and economy in the maintenance of track and equipment.

The four pairs of driving-wheels are equalized with the rear truck by a continuous equalization system on each side. The four-wheeled front truck is of the Economy constant resistance type. Long driving-boxes are used on the second, or main, pair of driving-wheels, and flanged tires are used throughout. Sufficient lateral play is allowed to permit the locomotives to traverse curves of 20 deg. Flange oilers are applied to the leading drivers.

The main frames are vanadium steel castings of most substantial construction, as they have a width of 6 in. and a depth over the pedestals of 6¾ in. The pedestal binders are of iron, and are held in place by three bolts at each end. The Commonwealth rear frame cradle is applied.

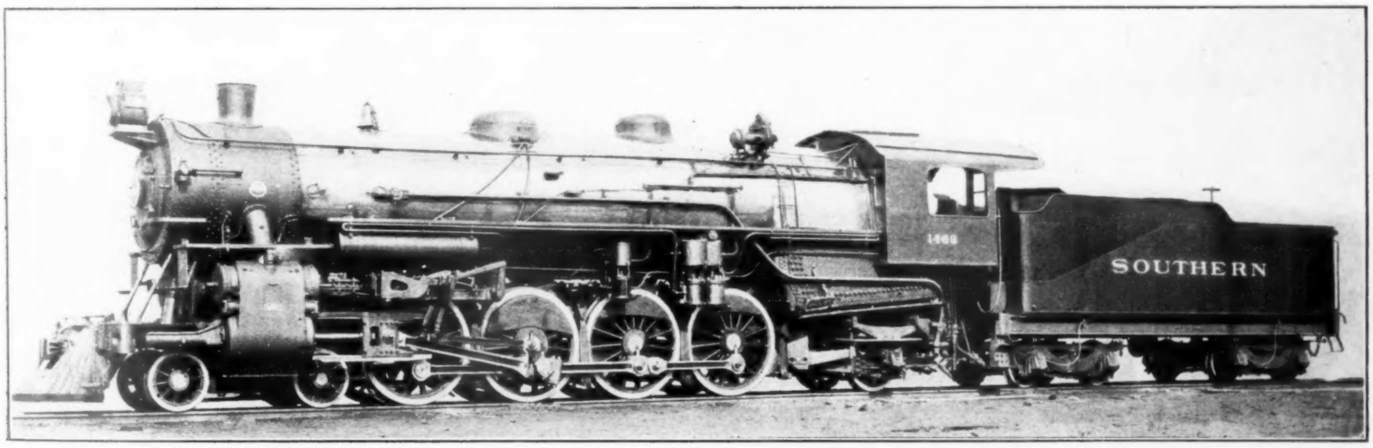
The steam distribution is controlled by 14-in. piston valves driven by the Southern valve motion, with which the railway has had an extensive experience, both in passenger, freight and switching service. In the present instance, the Ragonnet power reverse mechanism is applied.

The firebox is placed entirely back of the driving-wheels, and has a combustion chamber 44¾ in. long. In order to provide a free entry to the throat under the combustion chamber, a conical ring is used in the middle of the barrel, increasing the shell diameter from 76½ to 87 in. The equipment includes a Schmidt superheater, Security arch and power operated fire-door. The superheater flues are electrically welded into the back tube sheet.

Type.	Cylinders, diameter and stroke.	Diameter of drivers.	Steam pressure, lb. per sq. in.	Grate area, sq. ft.	Water heating surface, sq. ft.	Superheating surface, sq. ft.	Weight on drivers, lb.	Weight total engine, lb.	Tractive effort, lb.
Pacific	24 in. by 28 in.	72½ in.	185	54	3,058	660	141,500	232,300	35,000
Mountain	27 in. by 28 in.	69 in.	190	66.7	3,668	942	209,800	314,800	47,800
Mikado	27 in. by 30 in.	63 in.	175	53.3	3,198	699	215,700	272,940	51,700
Santa Fe	28 in. by 32 in.	57 in.	190	88	5,234	1,341	294,400	370,600	71,000

The tender is carried on equalized pedestal trucks, and has a frame composed of 12-in. logitudinal channels, with white oak bumpers. The coal and water capacity are 12 tons and 9,000 gallons respectively.

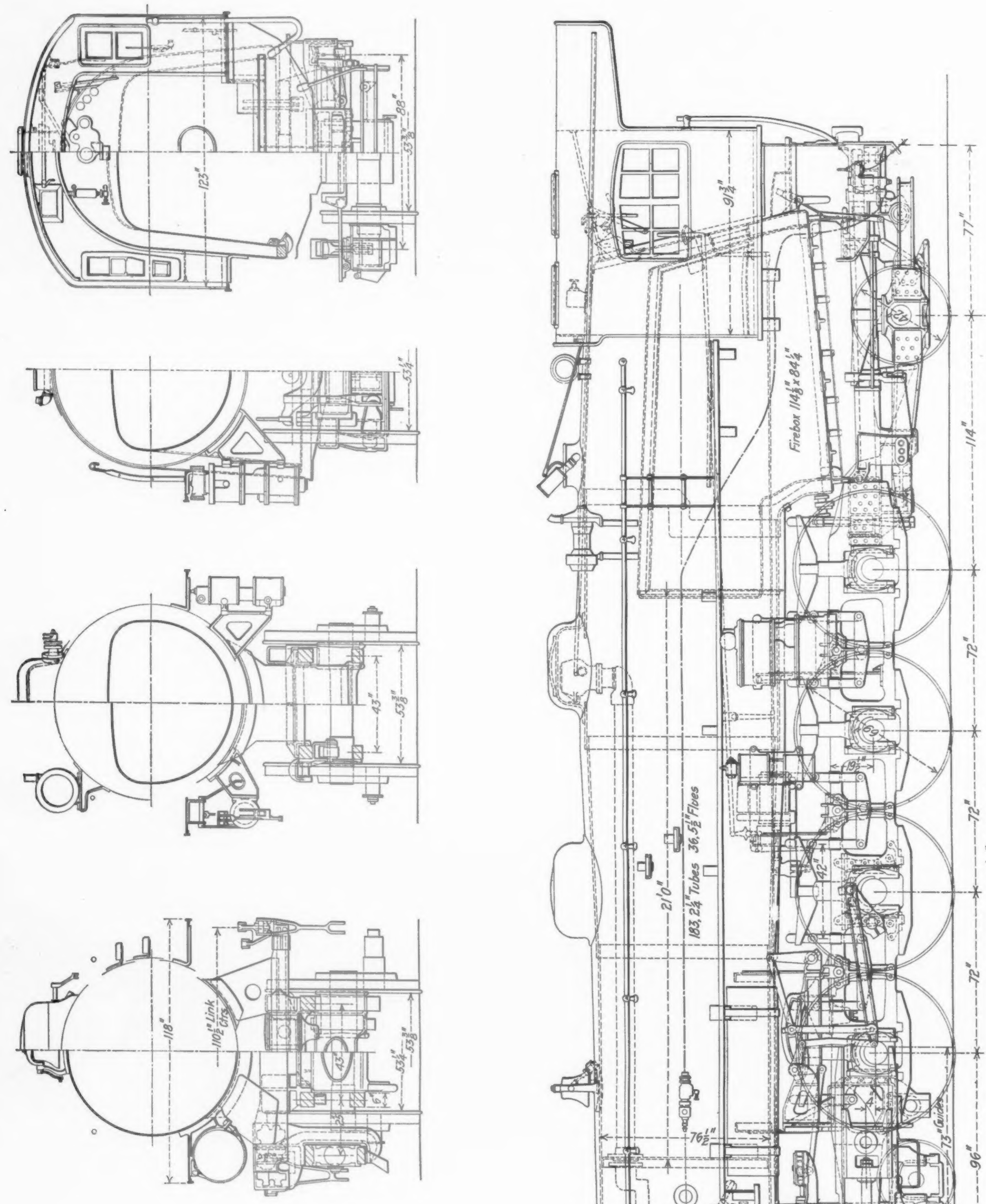
The Santa Fe type locomotives are replacing Mikados, a large number of which have been built for the Southern Railway by The Baldwin Locomotive Works. A comparison of these two types is also shown in the table.



Mountain Type Locomotive for Passenger Service—Southern Railway

Comparing the Santa Fe type with the Mikado, it may be noted that while the increase in tractive force is 37 per cent (approximately the same as the increase in total weight and in weight on drivers), the increase in total equivalent heating surface is 71 per cent and in grate area 65 per cent. Provision has been made for fully utilizing the high boiler power of the Santa Fe type engines, as they are equipped with mechanical stokers. The Street stoker is applied to 50 engines, and the Hanna stoker to the remaining five. As in the case of the passenger locomotives, the fireboxes have combustion chambers and brick arches. The boiler has a straight top, but the third ring is sloped on the bottom to allow a sufficiently deep water space under the combustion chamber.

Running gear details include lateral motion driving-boxes on the front axle, long boxes on the third or main axle,



Elevation and Sections of the Southern Railway Mountain Type Locomotive

Economy front truck, and Hodges trailing truck. The swings of the trucks and the lateral play between rails and flanges are sufficient to permit the engine to traverse curves of 16 deg. The wheels of the third, or main pair have plain tires. Flange lubricators are applied to the front and rear driving-wheels.

As the doors in the front wall of the cab are necessarily very narrow, a running board is placed below the cab on each side, and hand holds are placed on the outside of the cab below the side windows, so that the men can easily reach the main running boards from the firing deck. To keep within the clearance limits, the bell is placed on the curve of the boiler at one side of the center, and there are four sandboxes, placed two right and two left.

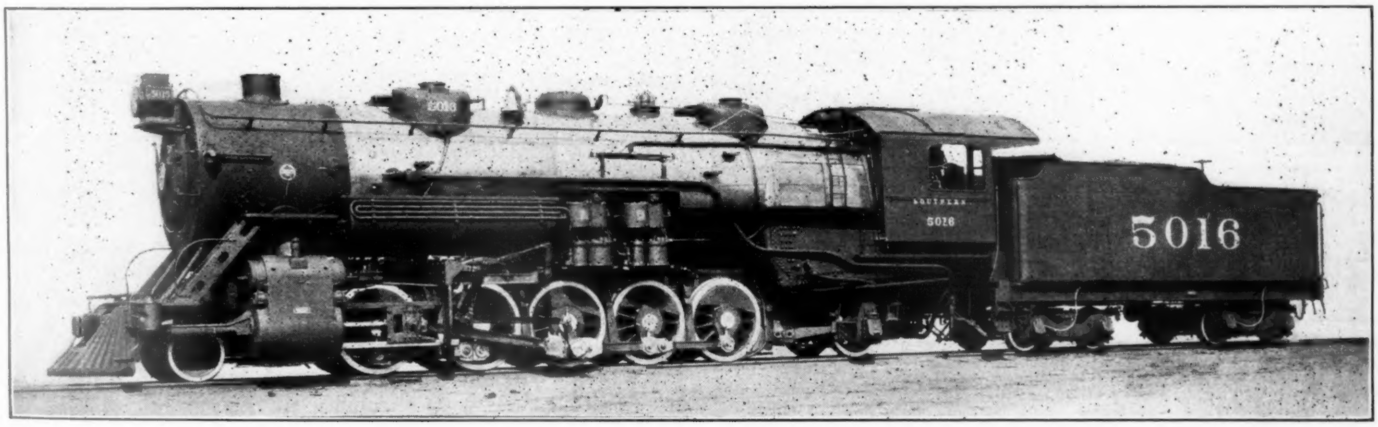
The tenders are of the same capacity as those used with the passenger locomotives, and are similar in design, with the exception of such changes as are necessary on account of the application of stokers to the freight locomotives.

The tables contain further particulars of the locomotives:

	4-8-2	2-10-2
General Data		
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Freight
Fuel	Bit. coal	Bit. coal
Tractive effort	47,800 lb.	71,000 lb.
Weight in working order	314,800 lb.	370,600 lb.
Weight on drivers	209,800 lb.	294,400 lb.
Weight on leading truck	53,800 lb.	26,700 lb.
Weight on trailing truck	51,200 lb.	49,500 lb.
Weight of engine and tender in working order (approx.)	480,000 lb.	546,000 lb.
Wheel base, driving	18 ft.	20 ft. 7 in.
Wheel base, total	38 ft. 11 in.	38 ft. 8 in.
Wheel base, engine and tender	73 ft. 3¼ in.	74 ft. 9½ in.
Ratios		
Weight on drivers ÷ tractive effort	4.4	4.1
Total weight ÷ tractive effort	6.6	5.2
Tractive effort × diam. drivers ÷ equivalent heating surface*	649.1	543.5
Equivalent heating surface* ÷ grate area	76.2	84.0
Firebox heating surface† ÷ equivalent heating surface,* per cent	6.5	5.1
Weight on drivers ÷ equivalent heating surface*	41.3	39.5
Total weight ÷ equivalent heating surface*	62.0	49.8
Volume both cylinders	18.6 cu. ft.	22.8 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	273.8	326.5
Grate area ÷ vol. cylinders	3.6	3.9
Cylinders		
Kind	Simple	Simple
Diameter and stroke	27 in. by 28 in.	28 in. by 32 in.
Valves		
Kind	Piston	Piston
Diameter	14 in.	14 in.
Wheels		
Driving, diameter over tires	69 in.	57 in.
Driving, thickness of tires	3½ in.	3½ in.
Driving journals, main, diameter and length	11½ in. by 21 in.	12 in. by 22 in.
Driving journals, front, diameter and length	....	11 in. by 20 in.
Driving journals, others, diameter and length	10 in. by 12 in.	11 in. by 12 in.
Engine truck wheels, diameter	33 in.	33 in.
Engine truck, journals	6½ in. by 12 in.	6 in. by 12 in.
Trailing truck wheels, diameter	42 in.	42 in.
Trailing truck, journals	9 in. by 14 in.	8 in. by 14 in.
Boiler		
Style	Conical wagon-top	Straight top
Working pressure	190 lb. per sq. in.	190 lb. per sq. in.
Outside diameter of first ring	76½ in.	88½ in.
Firebox, length and width	114⅛ in. by 84¼ in.	131¾ in. by 96 in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ⅝ in.	Sides, back and crown, ⅜ in.; tube, ⅝ in.
Firebox, water space	Front, 5½ in.; sides and back, 5 in.	Front, 6 in.; sides and back, 5 in.
Tubes, number and outside diameter	183—2¼ in.	259—2¼ in.
Flues, number and outside diameter	36—5½ in.	50—5½ in.
Tubes and flues, length	21 ft.	21 ft. 8½ in.
Heating surface, tubes and flues	3,339 sq. ft.	4,853 sq. ft.
Heating surface, firebox†	329 sq. ft.	381 sq. ft.
Heating surface, total	3,668 sq. ft.	5,234 sq. ft.
Superheater heating surface	942 sq. ft.	1,341 sq. ft.
Equivalent heating surface*	5,081 sq. ft.	7,446 sq. ft.
Grate area	66.7 sq. ft.	88 sq. ft.
Tender		
Tank	Water bottom	Water bottom
Wheels, diameter	33 in.	33 in.
Journals, diameter and length	6 in. by 11 in.	6 in. by 11 in.
Water capacity	9,000 gal.	9,000 gal.
Coal capacity	12 tons	12 tons

* Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

† Includes combustion chamber and arch tube heating surface.



Southern Railway 2-10-2 Type Freight Locomotive

GRAPHIC DISPLAY OF INDIVIDUAL DAILY FUEL RECORDS*

BY HIRAM J. SLIFER

The cost of fuel is one of the largest of the individual items that go to make up the total expense of railway operation. This fuel is used by 99,070 locomotive enginemen, divided into classes as follows:

Engineers and motormen, yard	12,797
Engineers and motormen, road—freight	24,226
Engineers and motormen, road—passenger	12,075
Firemen and helpers, yard	13,013
Firemen and helpers, road—freight	25,210
Firemen and helpers, road—passenger	11,749

These men were employed on 64,950 locomotives (301 electric, 8,688 switching), and hauled 32,334,466 passengers and 277,232,653 tons of freight one mile in the fiscal year ending June 30, 1915.

The magnitude of the question of interesting the employes in the importance of reducing the pounds of coal used may be considered stupendous, and it would be almost impossible to suggest any method for doing so, if its consideration is confined to the foregoing statistics. It is the purpose of this paper, however, to suggest an analysis of these statistics for the purpose of simplifying them, in order that they can be applied to the unit-man and the unit-machine in their respective classes of service, expressed in pictures that will

* Abstract of a paper presented at the 1917 Convention of the International Railway Fuel Association.

be understood and interesting, creating a competition that will reduce the unit consumption of coal.

In the first place, two grand divisions of the subject suggest themselves: fuel used by yard locomotives, and fuel used by road locomotives. The latter may again be subdivided under many headings, some of which are suggested:

Passenger	Freight
Mail trains	Stock trains
Limited trains	Meat trains
Express trains	Fruit trains
Through trains	Coded trains
Local trains	Dead freight trains
	Local trains

It is necessary that each of these classes be considered independently of the others, and for the purpose of illustrating how the graphical method may be applied to show the daily performances of individual men and machines the consideration of the subject is confined to the dead or drag freight trains, for the reason that they are in a class that predominates and consumes the larger percentage of the fuel. For the fiscal year of 1915 there were 9.8 enginemen and motormen and 10.2 firemen and helpers employed in freight train road service per 100 miles of line, and it should be safe and fair to estimate that an average freight division will not have more than five dead or drag freight trains passing over it in each direction every 24 hours. With this basis it should be a very simple problem to devise some graphical method by which may be shown a comparison of the amount of coal consumed by each of these 10 machines and the men employed thereon, to haul 1,000 tons one mile. The method must naturally be so flexible that it may be curtailed or extended to cover as few or as many men and machines as may be employed, and it must be applicable to all classes of yard and road service. It should be of such a character as to suggest its use and value for interesting other classes of employes.

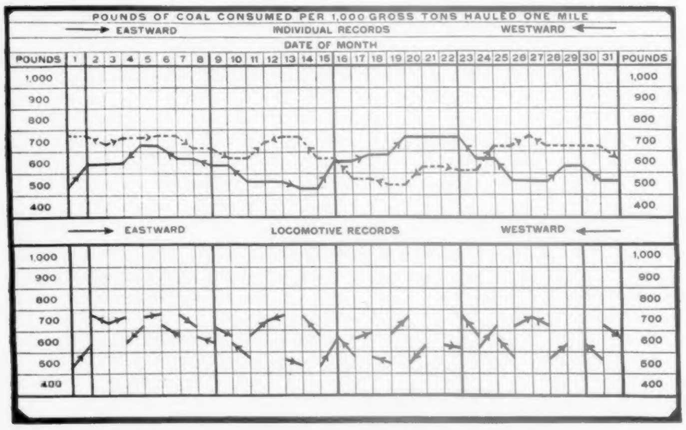


Fig. 1—Graphic Picture Showing Coal Consumed per 1,000 Gross Ton Miles

Some railroads have been for years, and are now, preparing daily statistics for the use of their general and division operating officers, and these are being secured by wire advice sent regularly to the chief despatcher. Such roads are already provided with the necessary data for determining the pounds of coal used, the tons hauled and the miles made by each individual and each machine. Other railroads should have no difficulty in establishing a similar system. Every despatcher's sheet now shows or should indicate the tonnage and mileage of every train on his district, and messages will give him a complete daily fuel record, when a few simple calculations will show the pounds of coal consumed in hauling each unit of 1,000 tons for a distance of one mile. If these figures in turn were wired to the master mechanic or the engine house foremen at the terminals, they would be available for illustration, as they are now on many miles of railroad. Up to this point there would be very little additional expense attached to the suggested plan.

The next step will be to establish the necessary boards on which these figures may be shown, through the medium of graphics. These will involve some slight expense, and this will be the only additional cost that will have to be met, as it is expected that some employee will be assigned to the few moments' duty necessary to mark up the day's record.

These boards should be on the walls of the rooms in which the enginemen register for duty. They should be conveni-

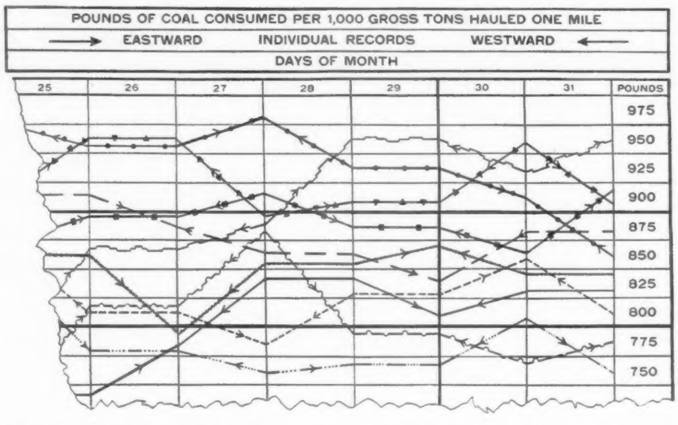


Fig. 2—A Detail View of the Corner of the Graphic-Picture Coal Consumption Board

ently located and well lighted. They may be of simple construction, with black background and white lines. The question of the number of boards to be maintained will depend on many things aside from the various classes of service to be covered. It will also be governed by the space which may be assigned to the boards. Every effort should be directed against any possibility of confusion, which will reduce the interest desired and expected. If the division is double track and of even grades in both directions, all of the records might be displayed on the same board by showing the direction of each train with an arrow, but where it is single track or grades predominate in one direction of traffic, the board should be divided to show the trains in each direction, which will mean the erection of a second board. The records on these boards may be made with white chalk, using different characters to represent each individual and machine, the characters to be known only to the officer and the man interested. If desired, the locomotive may be identified by its number and character.

The wall space available will dictate the shape, size and scale of these boards, which may be varied to suit the conditions. However, the vertical and horizontal proportions should be such as to show the daily unit consumption, distorted as much as possible, so as to emphasize the variations in the amount of coal used. A horizontal scale of 3 in. for each day, with a column for pounds on each side, will require a board 8 ft. wide; a vertical scale of 4 in. for each 100 lb., with the necessary space at the top for proper headings, another at the middle to separate the individual from the locomotive performances, and a third at the bottom for recording engine numbers, with their character or other information will require a board 5 ft. high to cover a variation of 1,000 lb. Such a board is shown in Fig. 1 with the record of one engine as worked by two men.

Some idea of the working appearance of the suggested board is shown in Fig. 2, which covers only one corner of the complete board, but which will show its application. This board shows coal consumed on the basis of gross tonnage, but the same principle may be applied to net tonnage and it may be modified as may seem desirable. It is believed that the employees will soon show by their improved records that the graphic representation of performance displayed each day, has created an interest that will repay the slight expense of its adoption in a very short period of time.

HANDLING HEAVY TRAINS ON GRADES*

While there are probably many shortcomings of the present practices of train handling on mountain grades, a thorough knowledge of the capabilities of the air brakes, together with a good organization for its proper maintenance, will enable very good results to be obtained.

Railways having heavy grades to traverse should establish convenient "dead line" points where their own and foreign line equipment may be properly inspected and repaired before it is permitted to proceed. Such points need not be where the descent of grade begins.

From records obtained at such points, where a thorough inspection is made, it has been ascertained that a large percentage of the brakes are in a very bad condition, showing excessive brake cylinder leakage. This inspection has also disclosed the fact that the retaining valve and its piping are receiving practically no attention by many railroads operating in level districts.

In order to successfully handle heavy tonnage trains on grades with air brakes exclusively, it is imperative that the retaining valves and pipe be in such condition that they can properly perform their work. It is also essential that brake cylinder leakage be reduced to the lowest possible point. A uniform adjustment of piston travel is required.

At the summit of grades a test should be made to ascertain if all brakes are operative, and piston travel adjusted to meet operating conditions.

All mountain railroad men should realize the importance of having the brake system charged to standard pressure before starting from the summit of any grade. Train and enginemen should have a knowledge of the tonnage allowed to be handled over the district, which should be prescribed by special instructions in the time tables.

During cold weather, when operating on grades of 4 per cent and when length of train will permit, it is advisable, immediately after starting and before the entire train is on the descending grade, to apply the brakes and work steam for a short distance for the purpose of wearing off any accumulation of snow and ice that may be between the wheels and brake shoes. Retaining valve handles must be turned to holding position before beginning the descent.

After starting from the summit the engineman should make the first application of the brakes as soon as practicable without stalling, and fully recharge while the speed is low. This is to test the holding power and get the aid of the retaining valves.

The speed of trains for the first mile should be exceptionally low for the purpose of allowing the wheels to assume a gradual heat, to compensate for expansion. The speed thereafter should not exceed schedule running time.

Speeds when on 4 per cent grade should not exceed 10 m.p.h. if braking conditions are favorable. If unfavorable, this speed should not be permitted. Speed and air pressure are the most important factors to be considered.

The engineman must understand that the critical time in grade braking is during the recharge of brake pipe and auxiliary reservoirs; also, that he should regulate the application of the brakes to maintain as near as practicable a uniform speed. To accomplish this the one reduction method must be followed, making a brake pipe reduction of sufficient amount to hold the train, and in recharging keep the brake valve in release position until brake pipe pressure is entirely restored before returning it to running position. Variation from the above practice is often resorted to by braking from release position and has given very satisfactory results.

When New York *B* brake valve is used it should be kept in release position at all times when brakes are released. In any case the release and recharge should be made as rapidly as permissible. Frequent applications and short holds are preferable to keeping the brakes applied for a long period. By using the short cycle method a more uniform speed can be maintained. This practice is being followed on many railroads where heavy grades are encountered.

Since the use of the hand brake for the control of trains is prohibited, except in cases of emergency, the retaining valve necessarily has to take its place in grade braking; safety depends largely upon its condition and handling.

When handling long freight trains, it is necessary to have the slack bunched in advance of the train brake application. There are several ways of doing this, but the important feature to be considered is to bunch the slack gently. This can be done successfully by the use of the independent engine and tender brake, but on account of the liability of bunching the slack too severely, the use of the independent or straight air driving brake for bunching the slack is generally condemned. However, it has been proven by experience that by the use of the independent or straight air brake on the locomotive tender alone, the slack can be gently and successfully bunched at moderate speeds without the danger of overdoing the matter and damaging equipment.

After it has been determined that all the slack is in, a moderate brake pipe reduction can be made with no shock of consequence in rear of train. If it is desired to make a stop, the driving brake must be cut in and permitted to work in conjunction with the train brakes.

It many times happens that the main portion of the train is passing over reverse curves with the locomotive and head cars on tangent track and descending grade. Under such a condition there is a tendency for the head portion to run away from the rear portion and the use of the independent brake on tender alone is found to be very beneficial in preventing the running and surging of train slack. In such cases the independent brake should be graduated on and when conditions have changed it should be graduated off.

By taking advantage of the many different conditions met with the independent brake used only on the locomotive tender will be found very valuable in controlling slack and eliminating the danger of slipping locomotive tires.

When a stop is made on ascending or descending grade and the locomotive brake is insufficient to hold the train, or where the engine is to be detached, sufficient hand brakes must be applied on head end to hold it on descending grade

* Abstract of a committee report presented at the 1917 convention of the Air Brake Association.

and on rear end on ascending grade. Under no circumstances should the automatic brakes be depended upon to hold the train while standing.

Liability of wheels sliding is greatest when starting after a short stop, when retaining valves are in use, and sufficient time should be allowed for the retainers to reduce the pressure before attempting to start. Train men should inspect from the ground for wheels sliding; hence, the necessity for the engineman to keep the speed low.

Short movements with long heavy trains should be avoided, but if necessary, a sufficient number of hand brakes must be applied throughout the train to control the slack.

The report was signed by: C. H. Rawlings, chairman; J. E. Fitzgerald, L. S. Ayer and Charles T. Goodwin.

DISCUSSION

On some roads retainers are tested when cars are on the repair track. The weight type of pressure retainer unseats at times due to jarring and pressure is lost. Many cars now in service have very low braking power and maintenance and also manipulation must be of the best. Some special cars used on heavy grades have been braked at 114 per cent on 60-lb. cylinder pressure with good results. The empty and load brake has facilitated the handling of large ore cars on heavy grades.

STEEL PASSENGER TRAIN EQUIPMENT

The Special Committee on Relations of Railway Operation to Legislation has issued bulletin No. 93, which shows that on January 1, 1909, there were in service only 629 all-steel passenger cars and 673 passenger cars with steel underframes, while on January 1, 1917, the number of all-steel cars was 15,757, and the number of cars with steel underframes increased during the same time to 6,386.

The statistics show that the construction of wooden passenger cars has practically ceased and the wooden cars still in service are being rapidly retired. The number of wooden cars in service January 1, 1912, was 48,126, but on January 1, 1917, the number was only 39,169. During the calendar year 1916 alone 2,213 wooden passenger cars were removed from service. The replacement of wooden equipment with steel can not be regarded as a profitable undertaking, but only as a measure of safety. The first cost of steel cars is higher and the available data, though meager, indicates that

Acquired in—	Total number	Percentages: Steel	Steel underframe	Wood
1909	1,880	26.0 per cent	22.6 per cent	51.4 per cent
1910	3,638	55.4 per cent	14.8 per cent	29.8 per cent
1911	3,756	59.0 per cent	20.3 per cent	20.7 per cent
1912	2,660	68.7 per cent	*20.9 per cent	10.4 per cent
1913	3,350	63.0 per cent	*30.4 per cent	6.6 per cent
1914	4,495	74.6 per cent	*29.9 per cent	4.5 per cent
1915	1,696	73.7 per cent	*20.1 per cent	6.2 per cent
1916	1,445	92.5 per cent	*7.3 per cent	0.2 per cent
January 1, [illegible] (under construction)	1,759	82.5 per cent	16.9 per cent	0.6 per cent

* This figure includes wooden cars reconstructed with steel underframes.

the cost of maintenance is considerably greater than for wooden cars. In its last annual report the Interstate Commerce Commission recommended "that the use of steel cars in passenger train service be required and that the use in passenger trains of wooden cars between or in front of steel cars be prohibited." In view of the fact that of the 1,445 passenger train cars built during the year 1916 only three, or 0.2 of 1 per cent of the total number, were of wood, any legislation of that sort seems quite unnecessary. It is interesting to note that only 7.3 per cent of the cars built in 1916 were of steel underframe construction, as compared with 92.5 per cent all-steel.

The number of cars of steel, steel underframe and wood acquired by the roads during the years 1909 to 1916 inclusive, is shown in the table above.

According to an act of Congress which was signed August 24, 1912, the railroads will not be allowed to use any full postal cars which are not of steel or steel underframe construction after July 1, 1917. The introduction of steel postal cars began before the passage of this act, however, as is shown by the following table:

Postal cars acquired in—	Steel	Steel Underframe	Wood
1909	52	30	5
1910	140	10	11
1911	286	88	11
1912	30	10	0
1913	101	18	0
1914	204	1	0
1915	19	3	0
1916	29	0	0

It is estimated that the steel passenger train equipment now in use on the railroads of this country has cost the roads $325,000,000. That the expense of the change from wood to steel has been borne by the railroads is proven by the fact that between 1909 and 1915 (the last year for which figures are available) the revenue per passenger per mile increased only 0.057 cents or from 1.927 cents to 1.985 cents per mile. There are now in service approximately 36,169 wooden passenger train cars. The committee estimates the cost of replacing these cars with steel equipment as follows:

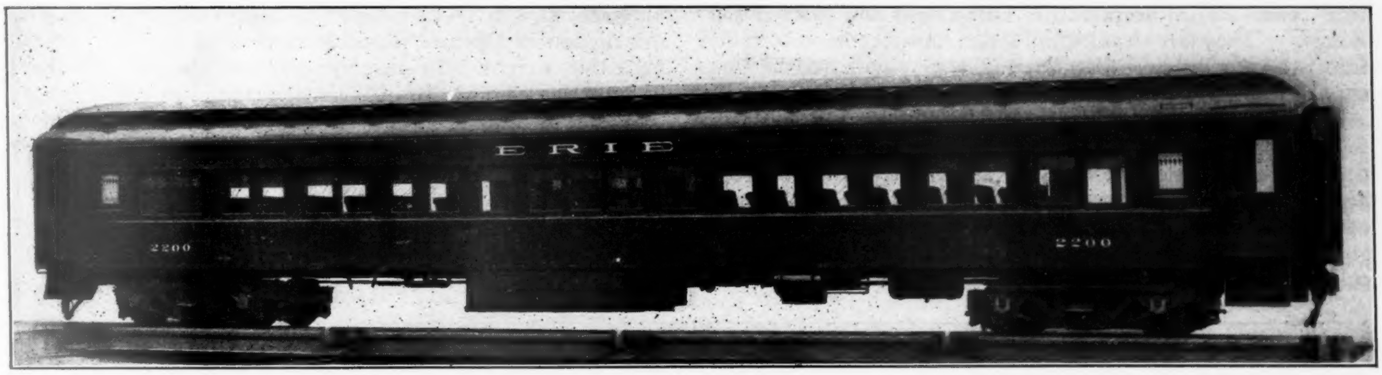
	Number	Average Cost	Amount
Postal	237	$19,000	$4,503,000
Mail and baggage	2,251	17,500	39,392,500
Mail, baggage and passenger	547	17,500	9,572,500
Baggage and passenger	3,129	17,500	54,757,500
Baggage or express	6,608	14,800	97,798,840
Passenger	20,906	23,000	480,838,000
Parlor, sleeping, dining	4,432	37,000	163,984,000
Business	736	26,000	19,136,000
Motor	323	35,000	11,305,000
Total	39,169		$881,287,340

The railroads will undoubtedly retire the wooden cars as rapidly as their earnings will permit. Assuming a value of $4,000 for each car repaired under the classification of accounts of the Interstate Commerce Commission, replacing this equipment will necessitate a charge to operating expenses of $156,676,000. At an annual rate of interest of five per cent, the annual charge on the investment required for this new equipment will be $44,064,367.

TYPE OF PASSENGER TRAIN EQUIPMENT IN SERVICE

Sections—	Number of roads	In service December 31, 1916: Steel	Steel underframe	Wood	Under construction or contracted for but not yet received on December 31, 1916: Steel	Steel underframe	Wood
New England	13	643	344	4,056	49	3	...
East	87	6,223	1,881	12,846	886	64	2
Southeast	63	548	603	4,212	235	2	3
Northwest	29	734	212	3,640	16	...	...
Southwest	49	678	452	2,876	40	...	...
West	52	3,652	1,491	8,922	103	42	5
Sleeping Car Co.'s	1	3,276	1,403	2,617	122	187	...
Total United States	294	15,754	6,386	39,169	1,451	298	10
			61,309			1,759	
Canada	8	108	385	4,780	51	...	...
			5,273			51	
Total U. S. and Canada	302	15,862	6,771	43,949	1,502	298	10
			66,582			1,810	
Classes of Equipment:							
Postal		909	194	237	51	1	...
Mail and Baggage		851	454	2,251	117	4	2
Mail, Baggage and Passenger		46	57	547	5	2	1
Baggage and Passenger		691	204	3,129	103	...	...
Baggage or Express		2,029	1,485	6,608	324	60	1
Passenger		6,047	1,906	20,906	658	42	6
Parlor, Sleeping and Dining		4,095	1,829	4,432	182	188	...
Business		42	152	736	10	1	...
Motor		1,044	105	323	1	...	...
		15,754	6,386	39,169	1,451	298	10
Total United States			61,309			1,759	

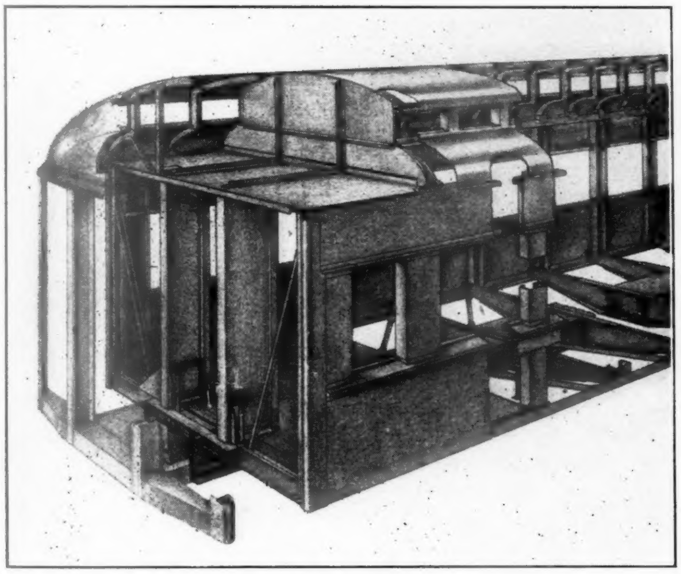
Mileage:	
United States	235,406
Canada	31,299
Total	266,705



ERIE STEEL PASSENGER EQUIPMENT

For Main Line Service; Important Features Are Light Weight and Strength of the Superstructure

An order of five all-steel coaches and one all-steel baggage car has recently been placed in service by the Erie Railroad. These cars, which were built by the Pressed Steel Car Company from designs prepared by L. B. Stillwell, consulting engineer, New York, weigh materially less than the steel underframe equipment now used by the Erie in similar service, and are especially noteworthy because of the distribution of metal in the superstructure, which provides an unusually stiff construction throughout. The light weight of the cars was made possible by following the same system of high truss side frame design, differing only in detail, that was used in the all-steel suburban cars built for the Erie about two years ago, and described in the *Railway Age Gazette, Mechanical Edition,* for July, 1915, page 356.

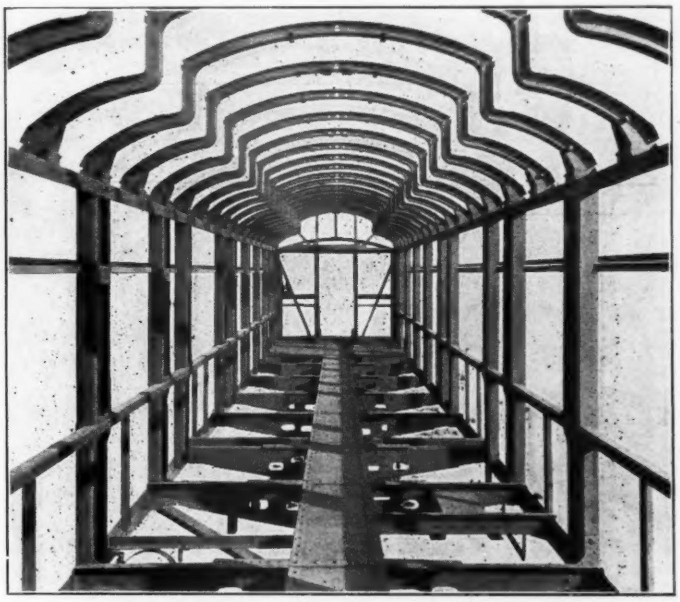


A Perspective View of the Anti-Collision Bulkhead Construction

This saving of weight is of importance not only in effecting a reduction in the first cost through the elimination of unnecessary steel, but also because of the possibility of changing from wood cars to all-steel cars in main line service, without taxing the capacity of existing passenger motive power. In many cases the advent of all-steel equipment has necessitated an increase in the size of locomotives used in through passenger service. A third, and no less important economy, will result from the reduction in the amount of fuel used per car-mile with the lighter weight.

Aside from the economic advantages accruing from the light weight, the design of the new cars is of interest because of the unusual strength of the car body which is designed especially with reference to its ability to resist destruction in collision or derailment. This is accomplished by the introduction of two new members in the body end, viz., a collision diaphragm forming a ceiling above the saloon, lavatory and passageway between, and special door posts in the body end frame.

The collision diaphragm consists of a horizontal plate girder having a 3-16 in. web member placed across the car from side plate to side plate, and extending lengthwise of the car from the door header into the body of the car about 5 ft. 6 in. This horizontal girder securely ties the side walls together at the ends of the car body, and it is expected that in collision the walls will thereby be drawn in to resist penetration, rather than be split apart to allow penetration. Also, this horizontal girder, being backed up by the high girder side frame and tied down by the door posts, is itself expected to offer great resistance to penetration.



Interior View Showing the Details of the Body and Underframe Construction

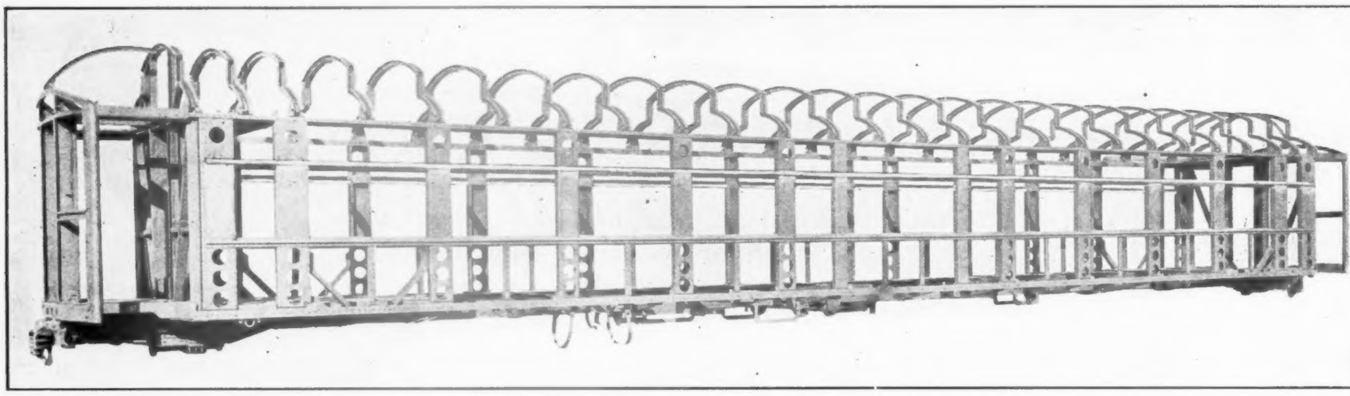
The special body-end door posts are in the form of ver-

tical beams 21 in. deep, with 3-16 in. web and pressed steel flanges. They are framed into the underframe below and into the collision diaphragm above, with connections capable of developing the full strength of the beams.

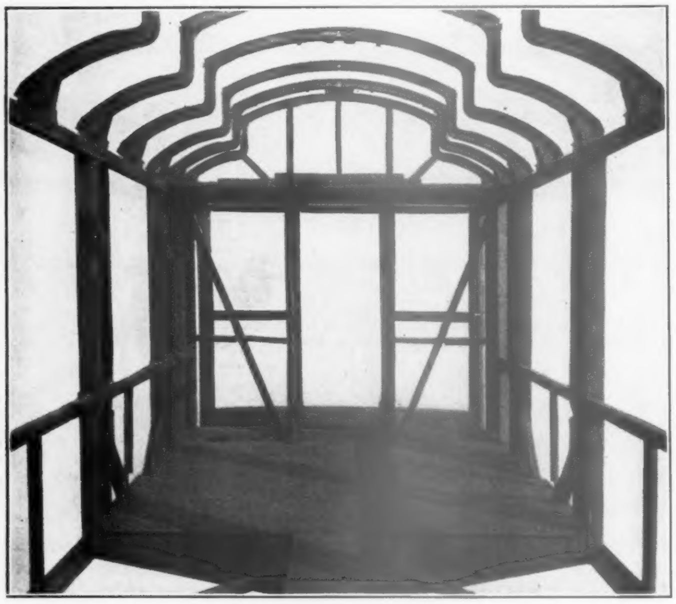
The arrangement of the body door posts and the anti-telescoping tie member is clearly shown in the perspective drawing of the end construction of the car. The vestibules are of the usual construction and obviously are less capable of resisting a severe shock than is the heavy body end construction. Consequently, if the car is subjected to a violent collision shock, the vestibule structure may be expected to close up against the body of the car and in doing so somewhat cushion the force of the blow. The further progress of the colliding body will be greatly checked, if not arrested by the heavy body end construction. This should greatly reduce, if not eliminate that most common and most destructive form of collision—the splitting open and telescoping of one car by one of its neighbors or by a locomotive.

This design is the result of a careful study of the effects of collisions and derailments upon cars, particularly those of all-steel construction, which has covered a period of six years. This study has been based upon personal inspection and examination of the photographic records of many accidents involving passenger equipment. As a result it is the conclusion of the designers that the heavy underframes so generally used in steel passenger train equipment not only afford little protection against damage to cars in derailment or collision, but in themselves not infrequently increase the destruction of life and property because of the effect of their excessive weight. In case of collision the underframe of at least one car in a train is usually raised at one end above that of the adjoining car. When this occurs, the greater the weight and strength of the underframe as compared with that of the superstructure of the neighboring car, the more effective it becomes in destroying that superstrucure.

The additional weight of material incorporated in the heavy body end structure is more than offset by the reduction in weight effected elsewhere in the design. The complete weight of the coaches, including the four-wheel trucks, but excluding the lighting equipment, is 111,000 lb. each. The weight of the car body is such that it may be carried on four-wheel trucks with journal loads well within the limits prescribed by good operating practice.



Side Elevation of the Steel Frame of the Erie Coaches



A View of the Framing at the End of the Car, Also Showing the Body Bolster and Underframe Stiffening Plate

The framing system of the through line cars is similar to that employed in the Erie suburban cars with the exception that the windows are rectangular, whereas those of the suburban cars were of the Gothic form. In each case the vertical members are framed together into a girder, the depth of which is equal to the full height of the side walls, and which acts as a load carrying member. This not only produces a car structure free from appreciable deflection, but greatly increases the safety of the passenger space in case of accident.

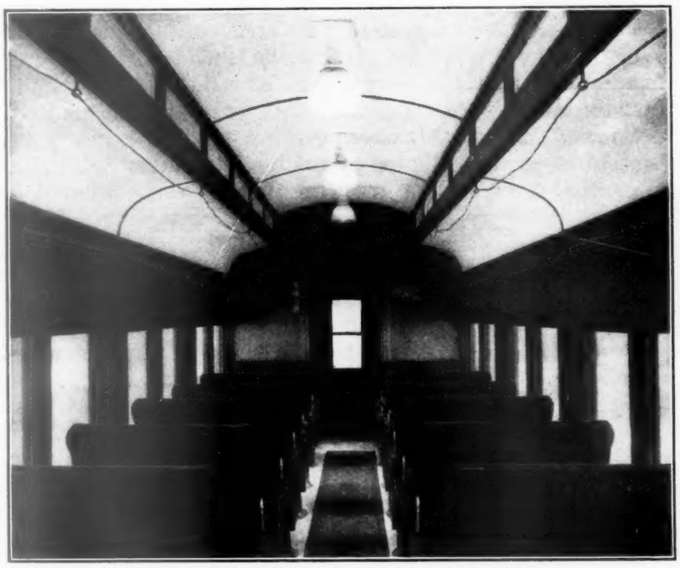
Four-Wheel Truck for Erie Through Line Coaches

The side frame of the car is in the form of a girder 7 ft. 7 in. high, with suitable openings for windows, and has for its bottom member the 4 in. by 3½ in. by 3-16 in. angle side sill, and for its top member the 3-16 in. pressed channel side plate, 5¼ in. wide. The side sheathing and letterboard are ⅛ in. plate, roller leveled. The main piers extend from sill to plate and are pressed steel channels with re-entrant flanges. Main piers, except those at the smoking compartment in the middle of the car, are 12 in. wide by 4⅞ in. deep, and are formed from various thicknesses of steel plate, as required by their respective locations in the car frame to develop the full depth of the side as a single girder. The piers are braced by the side sheathing and the belt rail below the windows, and by the letterboard and

upper belt rail above the windows. The lower belt rail is a channel-shaped pressing 3-16 in. thick and perforated to receive the main piers.

The center sills are composed of 12-in., 25-lb. channels, with a ⅜-in. top cover plate and 4 in. by 3½ in. by ⅜ in. bottom flange angles, and have a total cross-sectional area of 27.915 sq. in. They are supported and alined by the high girder side frame through the body end sills, bolsters and cross bearers which are placed at every main pier, 5 ft. 11 in. between centers, thus eliminating all possibility of deflection in a vertical plane. For bracing the center sill against horizontal deflection, 12 diagonal braces are incorporated in the underframe, which, with the side sills and cross bearers, form a horizontal truss brace 9 ft. 9½ in. wide. The diagonal braces are 4-in., 5.25-lb. channels. The cars are fitted with friction draft gear of the Miner A-3-P type and class B-10 friction buffers.

The double body bolsters are formed of 5-16-in. pressed diaphragms, 10-in. by ½-in. bottom cover plates, and a single top cover plate ¼-in. thick, as shown in one of the photographs, forward of this cover plate is a 3-16-in. floor plate extending to the body end sill. This plate securely ties the side sills, end sills and center sills. The cross bearers are all formed of 3-16-in. pressed diaphragms with 3½-in. by ¼-in. top cover plates and 5½-in. by 5-16-in. bottom cover plates.



Interior of the Erie Steel Coaches

The roof framing is shown in the two views of the interior of the car frame, and has been made to co-ordinate with the upper portion of the side walls in such a manner as to act effectively in combination with the collision diaphragm, to resist compression stresses and to protect the passenger space in case of overturning of the car through derailment. The roof sheets are 1-16-in. ingot iron, and the carlines are pressed channel, ⅛ in. thick. The clere story is fitted with Ward ventilators.

The seating arrangement of the new cars conforms to that of other cars now in Erie through line service, a smoking compartment seating 12 passengers being placed in the middle of the car. The walls of this compartment are fitted with leaded glass windows and the seats are upholstered in leather. The seats in the rest of the car are upholstered in plush. Each end of the car is fitted with a saloon and lavatory. The seating capacity of the cars is 76, including the 12 seats in the smoking compartment.

The illumination of each car is obtained from ten incandescent lamps set on the center line of the ceiling. Safety Car Heating & Lighting Company fixtures with Holophane shades are used. The power for lighting is furnished by a straight storage battery installation, consisting of a 16-cell, 1,200-ampere hour Wilson battery with lead lined cells. The capacity of this equipment is sufficient to furnish light for the round trip between Jersey City and Chicago without recharging.

The general features of the design of the truck are shown in one of the illustrations, and is similar to that used under the Erie all-steel suburban cars previously referred to, this design having proved very successful in service. The frame is of the riveted truss type and the spring arrangement is such as to secure a remarkably easy riding truck. The riding qualities are considered fully equal to those of the usual type of six-wheel truck. The trucks are equipped with the American Brake Company's clasp brake.

The general dimensions of the cars are given in the following table:

Length over vestibule end sills	78 ft.
Length over body end sills	70 ft.
Distance between truck centers	53 ft. 3 in.
Wheel base of trucks	8 ft.
Height of car over-all	14 ft. 3 in.
Height of car over sheathing	9 ft. 9¾ in.
Weight of car body	80,660 lb.
Weight of two trucks, complete	30,240 lb.
Weight of car without storage batteries	110,900 lb.
Storage batteries, boxes and hangers	8,700 lb.

SLACK ACTION IN LONG PASSENGER TRAINS*

Rough handling varying in degree of intensity is reported as occuring during ordinary service applications in handling long passenger trains. This condition is practically universal, although the frequency and severity in such cases vary under varying train conditions, brake conditions and methods of manipulation. The most severe shocks were encountered under low speeds and heavy brake applications.

In order to afford a basis from which the committee might analyze the varying conditions under which good and poor handling prevails, data was collected involving the principal elements to be considered.

Observations.—Some three thousand observations were reported on trains of from four to eighteen cars; however, for trains up to six and seven cars, little rough handling occurred during brake applications, and these not being due solely to slack action, but rather to sudden heavy increases of brake cylinder pressure at low speeds, which produced a high rate of retardation and sudden stops. Shocks involving slack action were confined to starting trains.

Number of Cars and Weight.—Reports received indicate that passenger trains of 14 to 15 cars are quite common in some localities, and that trains up to 18 and 20 cars have been handled successfully.

Table of make-up and weight of engines and cars:

General Make-up.		Total Light Weight.
(a)	Locomotive	195,000 to 508,000 pounds
(b)	Baggage Cars	37,900 to 135,000 pounds
(c)	Mail Cars	75,000 to 135,000 pounds
(d)	Smoking Cars	120,000 to 139,000 pounds
(e)	Chair Cars	95,000 to 140,000 pounds
(f)	Dining Cars	110,000 to 170,000 pounds
(g)	Club Cars	136,000 to 142,000 pounds
(h)	Sleeping Cars	112,000 to 170,000 pounds

Braking Power in Proportion to Light Weight of Cars.—

Engine.	Tender.	Cars.
60 per cent on 50 lb.	80 per cent on 50 lb.	80 per cent on 50 lb.
75 per cent on 50 lb.	100 per cent on 50 lb.	95 per cent on 55 lb.
		87½ per cent on 60 lb.
		90 per cent on 60 lb.
		91 per cent on 60 lb.
		95 per cent on 60 lb.
		100 per cent on 60 lb.
		113 per cent on 60 lb.
		85 per cent on 86 lb.
		90 per cent on 86 lb.

The general practice is to use 90 per cent braking power based on 60 lb. cylinder pressure, although several roads re-

*Abstract of a committee report presented at the 1917 convention of the Air Brake Association.

port the basis of 80 per cent on 50 lb. cylinder pressure, and 85 per cent on 86 lb. Pullman cars equipped with double LN brake at 80 per cent on 50 lb. pressure.

Approximate Average Load in Load Carrying Cars.—Baggage and mail cars are reported as carrying from 5,000 to 40,000 lb., a load of 20,000 to 30,000 lb. being quite common.

Brake Equipment.—PC, UC, PM, LN, J-6, S-1.

Slack Adjusters.—It is the general practice to equip all cars with slack adjusters, regardles of the type of brake.

Piston Travel.—Piston travel standing varies materially in different localities, as follows: Minimum, 5 in., 5½ in., 6 in., 6½ in., 7 in., 7¼ in., 7½ in. Maximum, 7 in., 7½ in., 8 in., 9 in.

Reports covering experiments with long piston travel, that is, 7 in. to 7½ in., indicate that such is preferable to a shorter travel, and also indicate that there is a tendency to maintain the piston travel considerably longer than the 5½ in. minimum so generally recommended. It is also stated that by changing 6 in. standing travel to 9 or 10 in., standing, all slack action was practically eliminated under the same method of braking, and that from the results obtained a 7½ in. standing piston travel was adopted.

Direct or Graduated Release.—There seems to be considerable difference of opinion with reference to the use of graduated release with such brake equipment as contains this feature. Of 24 reports, 11 show the use of graduated release and 13 the use of direct release.

Single or Double Brakes.—The major portion of the equipment reported is equipped with single brakes; that is, with one service brake cylinder. However, where Pullman cars are operated, reports quite generally show such cars equipped with double service brake equipment.

Instructions for Brake Operation.—Almost without exception it is the practice to begin the brake application with light reductions, from 6 to 8 lb., although in some instances the range is from 6 to 10 lb. Generally any succeeding reduction following the initial reduction is left to the judgment of the engineer. In releasing the common practice is to use release position of the brake valve, either with direct or graduated release, although running position is used as standard on one railroad, with the graduated release.

The practice of applying the brake before closing the throttle is becoming quite general and is reported as preventing slack action. It is the general practice to stop with brakes applied on the second application, where the two application method is used, if the train consists of more than 9 cars.

Type of Draft Gear.—Friction gear is used quite extensively, and appears to be coming into general use. In some instances entire trains are equipped with friction gear, although the type of draft gear in general service necessitates operating trains of mixed spring and friction draft gear.

Average Slack Between Cars.—From 1½ to 8 in. slack between cars has been noted in handling trains, the maximum occurring between the engine and first car. The average is about 2 in. per draft gear.

Strength of Draft Gear as Reflected by Failures.—It is evident from the investigation that draft gear generally is inadequate for present heavy passenger service, draft gear failures occurring universally in starting and stopping trains.

Type of Foundation Brake Gear.—While the single shoe type of brake gear is in use generally, the clasp type of brake gear is being gradually introduced throughout the country.

Pressures Carried.—Ninety and 110 lb. brake pipe pressure is the general standard, although in a few instances 70 and 100 lb. is the standard. The main reservoir pressure is generally controlled by a duplex compressor governor, set for 20 lb. excess in running position and 40 lb. excess pressure in lap position of the automatic brake valve.

Main Reservoir Capacity.—General practice is to use 50,000 to 60,000 cu. in. main reservoir capacity.

Slack Action.—Rough handling due to slack action both in starting and stopping trains is reported universally.

Proportion of Auxiliary Reservoirs to Brake Cylinders.—General practice is to use standard auxiliary reservoirs as specified by air brake companies for the various size brake cylinders, although it is found that auxiliary reservoirs much larger than the above are used.

It will be noted that the statements presented at the last convention with regard to rough handling of passenger trains throughout the country is confirmed; also that, in a measure, the causes as enumerated by them exist generally. However, the investigation has developed the fact that improvement is possible through instruction and reasonably close supervision with reference to brake manipulation and maintenance.

The investigation has also developed the fact that rough handling occurs due to methods of brake manipulation where modern brake gear and operating mechanism is in use.

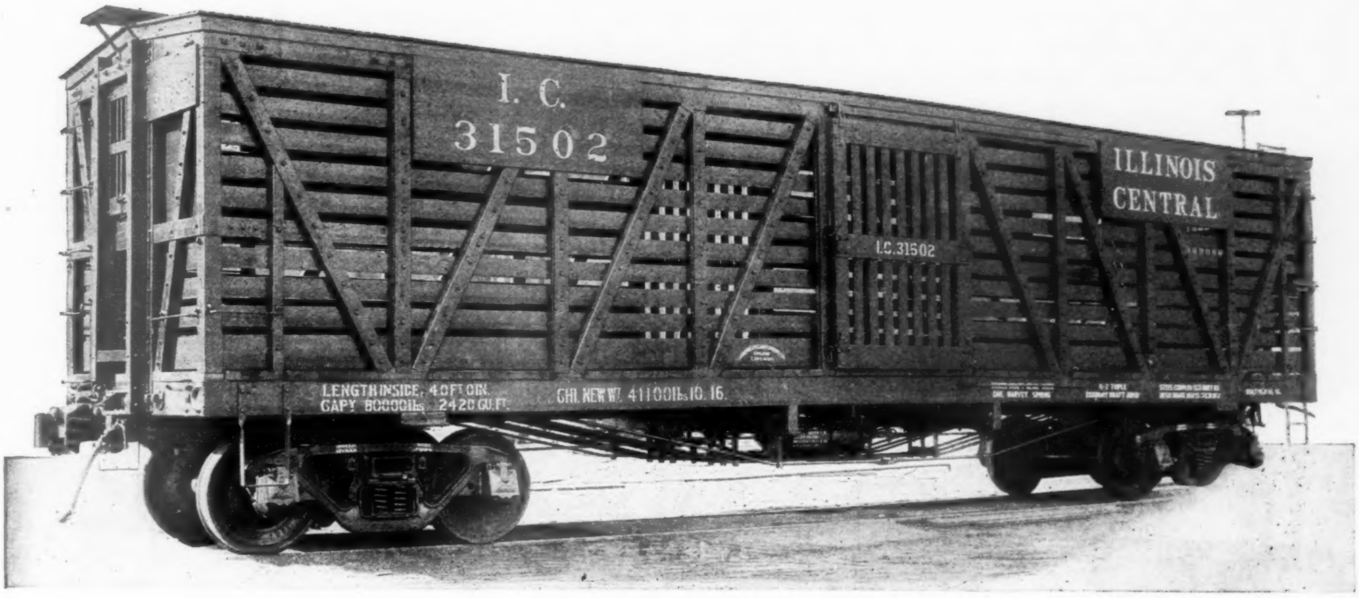
In order to determine the point brought out at the last convention, with reference to maintaining the proper proportion of brake cylinder and auxiliary reservoir volumes as specified by the air brake companies, one railroad company provided an 18-car passenger train for test purposes. The brake equipment on the cars was modified so that the auxiliary reservoir volumes were of such proportions that brake cylinder pressure would be built up in proportion to the brake pipe reduction so that the action of the brakes would very closely resemble the proportions intended by the brake manufacturers. It is very clear from the above tests that notwithstanding the fact that the brake was designed to provide a slow and prolonged service stop, the tendency has been to so change its proportions that its ability to produce a gradual and smooth stop has been greatly reduced or entirely destroyed. The fact has been established that rough or unsatisfactory handling of passenger trains is universally prevalent; also that an attempt is being made to overcome this condition by prolonging the time in which the train is brought to a stop during service applications, by certain methods of manipulating the brake. It is also established that it is possible under such manipulation to provide satisfactory handling, so far as brake applications are concerned, with the addition of a slightly increased flexibility obtained by a modification in piston travel adjustment.

The report was signed by G. H. Wood, chairman; W. F. Peck, M. E. Hamilton, Mark Purcell, C. U. Joy, L. S. Ayer, T. F. Lyons, L. P. Streeter, M. S. Belk, W. J. Hatch, C. H. Rawlings, J. A. Burke, R. C. Burns and Wm. Spence.

DISCUSSION

The report of this committee was accepted without discussion and the committee was continued for another year. There was, however, a discussion of the paper on this subject by J. A. Burke and W. Hotzfield, which was presented last year (see *Railway Mechanical Engineer* of June, 1916, page 299) but held over for discussion this year. The main points brought out in this discussion are as follows:

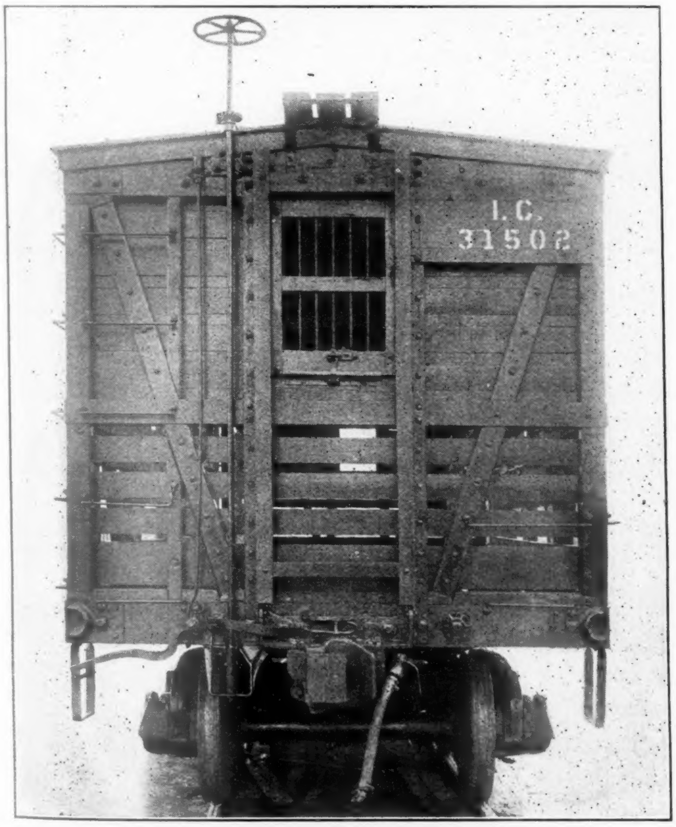
Bad shocks are experienced at times with all types of equipment but with proper manipulation satisfactory control of trains can be secured. Among the causes of shocks are variations in the braking power due to lack of uniformity of piston travel, non-standard auxiliary reservoirs, or design of foundation brake gear, and the tilting of trucks equipped with the single shoe type of brake. It has been found best to make a light application before closing the throttle, making any further reduction required to secure the desired braking effect in one application. It is not advisable to use the two-application stop with long trains. The brake equipment should be modified so that it would be easier for the engineman to avoid shocks. Relatively long piston travel is an aid in securing this result. The standard sizes of auxiliary reservoirs should be adhered to. The adoption of the clasp brake will result in a great reduction of shocks.



WOODEN STOCK CARS FOR THE I. C.

Cars Built Largely of Wood on Account of the High Price of Steel and Which Have Given Good Service

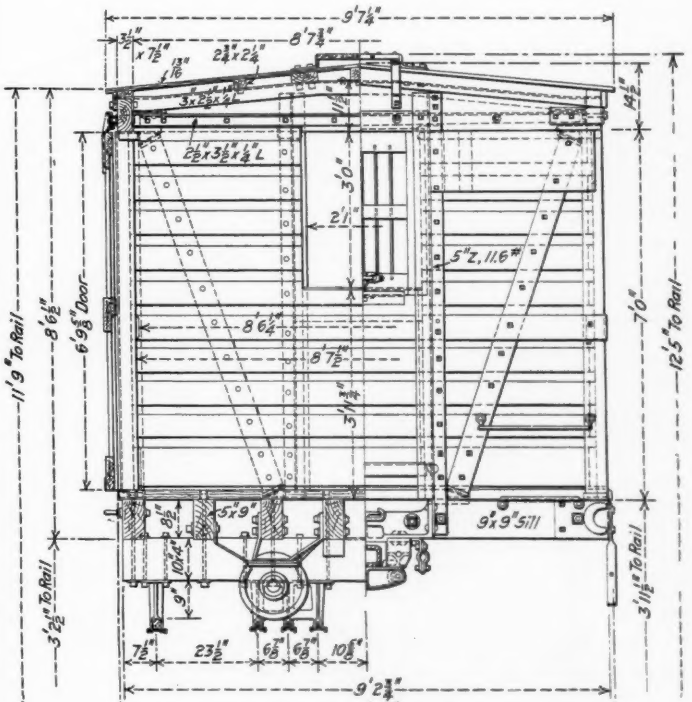
A SUCCESSFUL design of wooden car which was built to meet the present conditions is illustrated by the 300 stock cars which were delivered to the Illinois Central several months ago by the American Car & Foun-



End View of Illinois Central Wooden Stock Car

dry Company. These cars, which were designed by the railroad company, are constructed largely of wood, but have cast steel bolsters, draft arms and striking plates, steel reinforced ends and steel carlines. They have been so satisfactory that it is planned to build another lot of similar design.

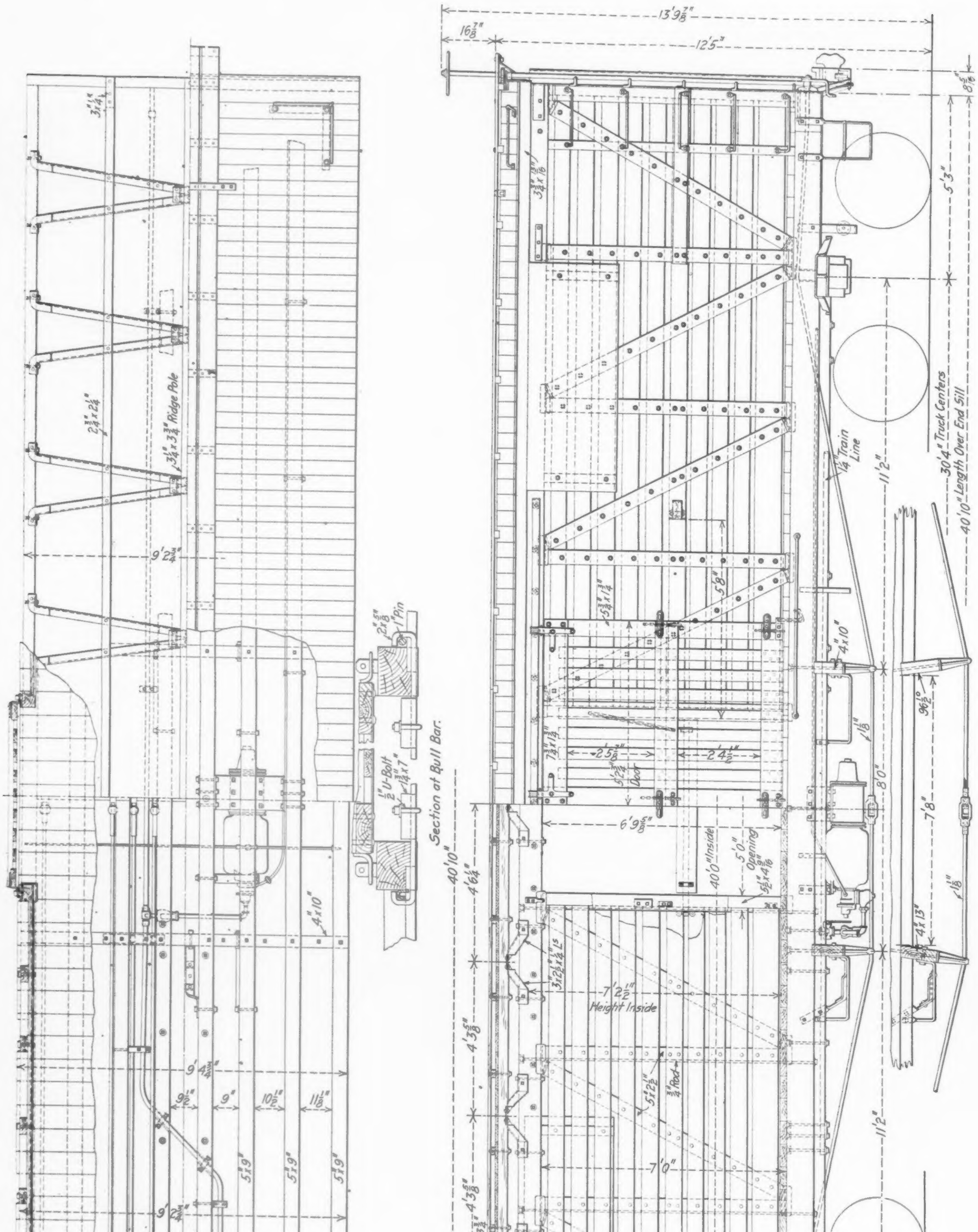
The cars are of 80,000 lb. capacity and have an average light weight of 41,000 lb. They are 40 ft. long inside and



Half End View and Section of Illinois Central Stock Car

40 ft. 10 in. over the end sills. The width between the belt rails is 8 ft. $6\frac{1}{4}$ in. and over the eaves 9 ft. $7\frac{1}{4}$ in.

The main draft members are made up of two 5-in. by 9-in. sills, to which are attached cast steel draft arms, designed to meet M. C. B. requirements. Above the draft arms and



Elevation and Plan Views of the Illinois Central Stock Car

riveted to them is a cast steel striking casting. Two of the truss rods pass through the casting and the Z-bar end posts are riveted to it on either side. The double pocket coupler is fitted with one M. C. B. Class G draft spring and one 8-in. by 8-in. friction spring. The end framing is a combination of steel and wood types. On each side of the door openings at the end is placed a 5-in., 11.6-lb. Z-bar which is riveted to the striking casting and bolted to the end plate. Inside the Z-bars and bolted to them are two 5-in. by 3¼-in. wood posts. The diagonal end braces are 5 in. by 3¼ in. and the ladder cripples are 3 in. by 3 in. The end belt rail is reinforced by a steel tie 5 in. wide and ⅜ in. thick fastened to the Z-bar end posts and to the side belt rail. Steel corner plates are fitted at the intersections of the side plates and end plates and side sills and end sills. The end slats and belt rail are 1¾ in. thick.

The underframe is made up of eight 5-in. by 9-in. sills, with cast steel bolsters and 4-in. by 5-in. sub-sills under the draft sills. The end sills are 9 in. by 9 in. and the needle beams 4 in. by 10 in. Waterproofing is applied over the sills under the floor. There are eight 1⅛-in. truss rods with 1⅜-in. upset ends arranged in two groups of three near the center line and two single rods close to the side sills.

The upper framing, except the ends, has wooden posts. The corner posts are 5 in. by 5 in., the door posts 5½ in. by 4 9/16 in. and the intermediate posts and king posts are 5 in. by 2½ in. The posts fit into malleable iron pockets at both top and bottom and are rabbeted to receive the ¾-in. vertical tie rods. The side plates are 7½ in. by 3½ in. mortised for the tenons of the end plates and tapered on the upper edge to conform with the roof purlines. The center belt rail is 1¾ in. by 5½ in. and is located 2 ft. 10¼ in. from the floor. The bottom belt rail, or base board, is 1¾ in. by 9 in. set to give ¾ in. clear opening above the top of the floor. The side slats are 1⅛ in. by 5½ in. spaced with 2-in. openings between the slats. The belt rails and slats are bolted to the side posts and all inside edges are rounded. The flooring is 2¼ in. thick, butt edged. At the side door threshold a 2½-in. by 2½-in. by ¼-in. steel angle is applied.

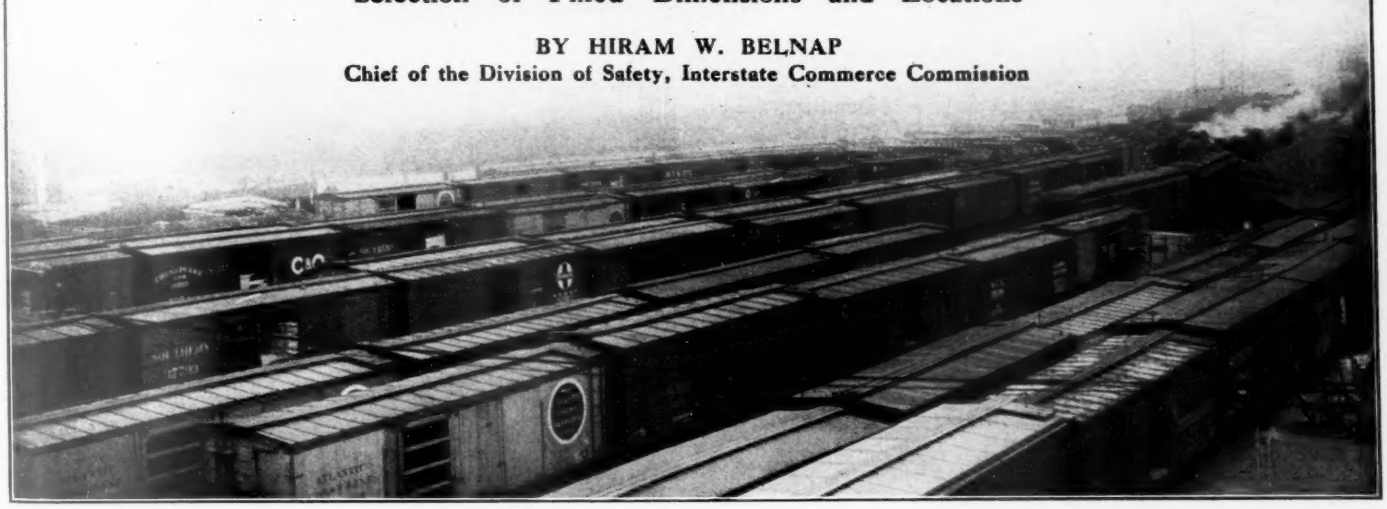
The roof is of the single board type 13/16 in. thick. The ridge pole and the four purlines are of wood supported on carlines of 3-in. by 2½-in. by ¼-in. angles which are bolted to the side plates. Cast steel side frame trucks are used under these cars. The air brake is the New York Air Brake Company's schedule C F-C-10.

The Illinois Central is now planning to build several hundred stock cars in the company's shops which will be duplicates of the former order. There will also be built box cars which will be of similar construction but equipped with all-steel ends, steel roofs and metal-bound doors.

The Safety Appliance Standards*

Necessity of Federal Control; Reasons for the Selection of Fixed Dimensions and Locations

BY HIRAM W. BELNAP
Chief of the Division of Safety, Interstate Commerce Commission



In the early days of railroad operation the safety appliance equipment of cars on different railroads was arbitrarily fixed by different operating officers, and then, as now, opinions varied widely. In those days the interchange of cars was not thought of; and there was no necessity for any uniform standard.

As the carriers' business grew, however, the necessity of eliminating delay incidental to transfer became obvious, and when the cars of one railroad began to be delivered to other railroads one of the first lessons learned in this school of experience was the fact that better service could be given, repairs could be more promptly attended to, and a greater degree of safety for trainmen and switchmen could be provided by fixing standards for many of the appliances used on cars. For the purpose of creating a satisfactory medium for a study of such problems, the Master Car Builders' Association, or rather the National Car Masters' Association, as it was first called, was organized. I shall endeavor to show how closely the recommended practices and safety standards of the Master Car Builders' Association have been followed in the safety appliance standards fixed by law and by the Interstate Commerce Commission's order.

The early records of the association are incomplete, but the minutes of the third annual meeting, held at Chicago, June 9, 1869, contain quite a full discussion concerning a resolution offered, fixing a standard height for bumpers. In this discussion it is said:

"Consequently, it is necessary, both for economy and safety to men in coupling, also for rapidity in making up

*From a paper read before the Cincinnati Railway Club, May 8, 1917.

trains, that the height of drawbars be as uniform as possible. Everyone familiar with the making up of trains knows that it is in consequence of the great difference in the height of buffers that so many of our men employed in coupling trains are injured and lives lost, because drawheads do not come in line, one being high and another low, thus driving by and crushing the man that is in performance of his duty, or maiming him, frequently, for life."

It will thus be seen that one of the very earliest matters discussed by the Master Car Builders' Association was standardization, dealing with a condition which at that time resulted in more accidents that occurred from any other one cause. Indeed, the record shows that the question of personal safety of employees received prominence in the discussions before there was any discussion concerning rules of interchange between carriers.

Eight years later the matter of a uniform and standard location for ladders was first discussed, and while the idea received support, there were differences of opinion as to whether the ladders should be placed on the sides or on the ends of the cars. This difference of opinion continued until 33 years later when the Interstate Commerce Commission settled the dispute by requiring both end and side ladders on all cars requiring ladders.

In 1879 the association adopted the recommendation that running boards on cars should not be less than 18 in. in width and project 5½ in. beyond the end of the car, the projecting end to be supported by two metal braces; and that there should be two good, substantial steps of wrought iron of 1¾-in. by ½-in. metal, fastened on each side sill at diagonal corners of the car; and, further, that each box and stock car should have two ladders of not less than five steps each, of ⅝-in. round iron, projecting 3½ in. from the siding of the car, securely fastened to each end of diagonal corners, with a roof handhold directly over the ladder, the lower step of the ladder to be provided with a guard.

In 1885 a committee reported upon the comparative advantages in the construction of freight cars with or without end platforms, and laid the foundation of what is now covered in the Commission's order under the heading, "End Ladder Clearance."

Recognizing that in order to provide proper safety there should be a uniform location for hand brake shafts, a committee in 1875 recommended that the best possible position for brake shafts was the left-hand corner of the car as one stands on the track facing the end of the car. While no definite action was taken on this recommendation at that time, it was adopted in 1879. Regardless of this fact, however, thousands of cars were placed in service that did not comply with this recommendation. Thirty years later, in 1909, a committee submitted to the Master Car Builders' Association a report definitely fixing certain standards in the construction of the hand brake. This report was submitted by letter ballot to the membership to be adopted as recommended practice. The hand brake arrangement described in that report is the standard hand brake required by the Commission in its order issued two years later.

If there be any doubt in the mind of anyone as to the necessity of legislation definitely to fix and locate standard safety appliances, this study of the record of the Master Car Builders' Association appears to be convincing. The recommended practices and the standards fixed by that association, which are well recognized as the safest and best, but which were not mandatory, were deviated from in such a radical manner that it was only through the strong pressure of legislation that they could be made positive and permanent.

When the question of arranging for the number, dimensions, location and manner of application of the appliances required to be fixed by the Commission was taken up, the committee representing the Commission, in conference with a committee designated by the president of the American Railway Association, was instructed to follow as closely as possible the M. C. B. standards and recommended practices concerning these appliances. In so far as it was possible to do so and provide the proper factor of safety, these instructions were strictly adhered to. In some of these regulations the dimensions or location of an appliance are fixed to the inch, and even to the fraction of an inch; and while this may seem upon superficial view to be arbitrary and unreasonable, the specified measurement in every instance is founded upon a good, substantial reason.

Mere uniformity is not alone the reason for the exact specification of measurements; the question of safety is also involved. But the measurements prescribed are also of incalculable practical advantage in enabling every railroad company to carry in stock appliances which, whenever repairs are necessary on any foreign car while on its line, will be found available.

There were two good reasons why the hand brake was definitely located on the left side of the car. A large majority of cars already had the hand brake on the left side, and the M. C. B. recommended practice called for the hand brake on the left side of the car. Uniformity of location was required so that the hand brake could be located by an employee with certainty even though he were working in great haste. Locating the hand brake definitely on one side of the car also removed the danger of an employee being fouled by the hand brake wheel on the adjoining car, which sometimes occurred where brake shafts were applied indiscriminately.

The order requires the hand brake and air brake to operate in harmony. It is a well known fact that if the hand and air brake do not work in harmony a dangerous condition exists because the air brakes may be applied suddenly while an employee is operating the hand brake. He is then in danger of being thrown from the top of the moving car, or in case a club is being used, of being struck in the side with sufficient force to break a rib. I have seen brakemen with their sides bruised and bleeding from being struck by their brake clubs when using the hand brakes to assist in holding trains on heavy grades.

Brake shaft size is fixed at not less than 1¼ in. in diameter. Brake shafts of smaller diameter were too often twisted off when brakemen attempted to stop heavy drafts of cars in hump yards where brake clubs were used in the ordinary performance of their work. The requirement that the brake shaft should be without weld is for the purpose of establishing with certainty as far as possible that the brake shaft is of clean, clear metal. Prior to the adoption of these standards inspection disclosed hand brakes with shafts broken at the weld. This led to the conclusion that it is not feasible in practice to determine merely by inspection whether or not a weld is a good one.

The requirement that the brake wheel shall not be less than 15 in., preferably 16 in., in diameter was adopted because it established a proper ratio in connection with the ratchet wheel, which was to have not less than 14, preferably 16, teeth. For every three inches the hand on the brake wheel moves, the ratchet wheel is moved forward one notch, thus furnishing the greatest degree of efficiency, and at the same time providing the greatest factor of safety for the employee manipulating the hand brake. If there were fewer notches in the ratchet wheel, the hand would travel much farther to reach a notch in the ratchet wheel, and in many instances efficiency of the hand brake would be impaired. The requirement that the brake wheel shall not have less than four inches clearance was for the purpose of providing sufficient room for an employee's hand when using the hand brake, as well as to correct an evil that was developing in equipping high-side steel gondola cars with brake wheels that barely cleared the tops of the ends of the cars, leaving

but little room between for the brakeman's hands and not enough for a brake club.

It may be interesting to know why the brake shaft was located not less than 17 in. nor more than 22 in. from the center of the car. The cars of greatest width at the time the Commission's order was under discussion were practically 10 ft. wide. One-half of this width left 5 ft. on each side from the center of the car. Beginning at the center of the car the first requirement to be met was that the running board must be not less than 18 in., preferably 20 in., in width. This took 10 in. of the five feet. If a 16-in brake wheel is used, one-half the wheel extending from the staff to the edge of the running board would require the staff to be 18 in. from the center of the car, and it was to prevent the location of the brake staff nearer the center that this minimum distance is prescribed, and under no circumstances can the brake wheel foul the running board. On many cars a brake-step board is used. To provide proper safety its minimum length should not be less than 28 in., and by restricting the location of the hand brake shaft to not more than 22 in. from the center of the car, the brake-step board extends beyond the brake shaft a sufficient distance to furnish secure footing to employees, and at the same time does not extend beyond the inside clearance of the end ladder. Inasmuch as the outside end of end ladders may be as far as eight inches from the side of the car, a minimum length of tread of 14 in. is established for end ladders for the reason that all cars were not of sufficient width to insure the use of a ladder with 16-in. treads. Following these standards, cars can be built so that the ladders, brake-step boards, hand brakes and running-boards will each furnish their full factor of safety without interference.

In order that the hand brake wheel might not encroach too far upon the end ladder clearance and thus be a menace to brakemen using end ladders, the order provides that the brake wheel shall not extend to within four inches of the vertical plane limiting this clearance. By such an application, protection is furnished employees when using the hand brake, and they are protected from being struck by any portion of an adjoining car.

All of the arrangements shown in the Commission's order relative to the method of attaching the brake wheel and the ratchet wheel to the brake shaft, the brake chain to the brake shaft drum, and other details of construction were adopted for the reason that, after having been carefully considered by the Master Car Builders' Association, they had been recommended as furnishing the proper factor of safety.

The safety appliance act specifies that all cars requiring secure running boards shall be so equipped. The Commission's order fixes their width at not less than 18 in., preferably 20 in., and requires that they shall run the full length of the car at the center of the roof. The width of running boards is practically the same that was established as early as 1879 as the proper and safe width for running boards by the Master Car Builders', and as the minimum that will furnish a proper and safe pathway for employees while passing over cars that many times are moving at high speed. In icy or frosty weather great danger exists by reason of employees slipping while trying to descend from the tops of cars with metal roofs, and to meet this condition the order requires on such cars latitudinal extensions of not less than 24 in., in width. Refrigerator cars are usually equipped with ice hatches at the corners, and if so equipped, do not require these latitudinal extensions, as the danger of slipping is not present. Running boards on some cars had trap-doors in them that were often left open; and then, too, employees were constantly being injured by falling from and being thrown from the tops of cars by reason of tripping over the nails and other insecure methods of fastening running boards. To remove these dangers the order states that while the running board may be made up of a number of pieces, it can not be cut or hinged at any point and must be securely fastened with screws or bolts. Considerable difficulty was experienced in making it understood that the so-called drive-screws or fluted nails could not be used in place of screws or bolts for the purpose of securing running boards to saddle blocks. Experience has shown that such drive screws do not properly perform the work demanded and their use is clearly a violation of the standardization order of the Commission.

Recognizing the ever-present danger to employees in passing from car to car, special provision is made to extend the running board beyond the ends of some cars for the reason that unless this is done the distance would be entirely too great for the average man to step from one car to the next one; and at the same time in order to prevent the running board projecting so far beyond the end of the car as to strike adjoining cars, the order provides that the ends of running boards shall not be less than 6 in. nor more than 10 in., from the vertical plane from which end ladder clearance is reckoned. When running boards project more than four inches from the edge of roof of car they must be securely supported so that in case an employee should step on the extreme end no danger will be encountered by the breaking off of the end of the board.

Both observation and experience had shown that unless a proper sill step is furnished, men will step on the arch bars, oil boxes and brake beams, even clinging to the ends and sides of the cars, while doing switching. To furnish proper safety, sill steps of sufficient width of tread and close enough to the ground to be used conveniently, furnish the only means possible to prevent employees using other and more dangerous footholds in their work. A great many cars were already equipped with four sill steps and four ladders at the time the Commission's order was promulgated, and this condition was advanced as one of the reasons why all cars should be so equipped. It was finally determined that four sill steps were required on cars to furnish a proper degree of safety to men in switching. The M. C. B. recommendation as to cross-sectional area for sill steps and dimensions for ladder rungs was adopted for the reason that experience had demonstrated their safety.

The distance at which the sill step should be placed from the top of the rail, what should be the proper spacing of ladder treads and what distance should be maintained between the ends of cars was determined after interviewing and carefully measuring nearly 1,000 railroad men in different terminal yards. This scientific and practical method of determining how high sill steps should be from the top of the rail, what distance was necessary between the ends of the cars in order to provide proper safety to the men using end ladders, as well as to ascertain the proper spacing of ladder treads, was undertaken so as to establish beyond question just what dimensions were proper and should prevail. It was found by these measurements that a man's average perpendicular step was about 19 in. To prevent the application of ladder treads of uneven spacing that might be a menace and mislead employees using ladders, particularly at night, it was decided that the spacing of ladder treads should be uniform, a variation of no more than 2 in. being permitted. A maximum distance of 19 in. was fixed so that the average step a man may desire to make in ascending or descending a ladder could not be exceeded.

The question of end ladder clearance was determined after it had been found that the average measurement of a man from his hip to his knee was 22⅞ in. Cars were being built with end ladders that constituted a menace to employees required to use them, for the reason that the clearance space furnished at the end of each car in some instances did not exceed 8 in. or 9 in., and in some cases where cars had truss rods extending across the ends, even this slight free space was encroached upon. It can thus be seen that a fundamental safety requirement demands the end ladder clearance required on

every car. Safety for employees using end ladders requires a space between the ends of the cars greater than this average distance, so for this reason it was determined that when cars were coupled together the ends of the cars above the end sills should not be closer than 24 in. It was found that this could be provided in all classes of equipment by fixing the basic point from which to measure on a line in a vertical plane passing through the inside face of the knuckle when closed, with the coupler horn against the buffer block or end sill. This end ladder clearance is only required for 30 in. from the side of the car for the reason that that distance was found sufficient to cover the end ladder location on all classes of equipment.

If end ladders only were provided on cars a material element of danger would be present in using them when switching in yards and also on account of the closing in of cars at the corners when rounding curves. For every degree of curvature the cars at their corners close in .42 in., so that on 10 to 15-deg. curves, many of which exist in yards, the corners of the cars are from four to six inches closer together than when the cars are on straight track. To eliminate this danger side ladders, as well as end ladders are required. On the other hand, if only side ladders were provided on cars, there would be a material element of danger in using them on account of the close clearance of many bridges, tunnels, buildings, freight houses, and the extremely limited clearance between tracks, particularly in the eastern portion of the country, where the tracks were built when cars were much narrower than the present equipment. The end ladder furnishes protection when working in such places.

The proper location for side and end handholds was determined in the same manner as the location of sill steps, spacing of ladder treads, and end ladder clearances. Employees were interviewed and measured for the purpose of determining at what point it was best to place these safeguards, and it was found that by placing the side and end handholds not to exceed 30 in. above the center line of the coupler, the best possible location was provided. In order to prevent handholds being applied too far below this location and to establish practical uniformity, a variation of not to exceed six inches below this point was named as a limit. In addition, in order to provide proper safety for employees required to couple and uncouple air hose, it was found necessary to place handholds on the face of the end sills so that in case cars were suddenly or unexpectedly moved an employee might have a close and convenient handhold to grasp and thus protect himself from serious injury or possible loss of life.

On cars that have platform end sills an additional end handhold is required, placed not more than 60 in. above the platform end sill. This handhold serves as a protection to employees when crossing over cars on the end sills and its necessity is plainly apparent. The earliest recommendation covering handholds made by the Master Car Builders' Association provided that they must be two feet in length, but this dimension had been changed from time to time until handholds 12 in. in clear length were recognized as meeting safety requirements. When the question of definitely fixing the dimensions required by the safety appliance acts came up for discussion by the committee fixing the standards, it was very readily decided that no handhold would furnish the proper factor of safety to employees unless its clear length be at least 16 in. After consideration and further investigation of all classes of cars, a slight modification was permitted in the equipping of cars with certain end handholds 14 in. in length. This can be done only when the construction of the car renders it impossible to use 16 in. handholds.

The many types of couplers led to the use of several different kinds of uncoupling mechanisms. Uncoupling levers that were actually a menace to the employees required to use them were in use on some classes of equipment. A recently made tabulation of all the cases that have been prosecuted under the safety appliance acts disclosed the interesting fact that approximately one-half were for inoperative and defective uncoupling mechanisms. The Commission's order does not require any particular type of uncoupling lever, but clearly states that the uncoupling levers may be either single or double and of any efficient design. They must extend a sufficient distance from the center of the car to insure that an employee using them shall not be between the ends of the cars while doing so, and if of the rocking type, safety requirements are only met when a lock or stop is used that will prevent the inside end from flying up and over in case of breakage, as accidents from this cause have frequently occurred.

In the early records of the Master Car Builders' Association are found many discussions relative to the use of lag screws and even nails in applying handholds, ladder treads and other appliances on cars. For many years it has been recognized as the best practice to use only bolts or rivets. The safety appliance acts required that the manner of application should be definitely fixed, and inasmuch as the greatest safety could only be furnished by the use of bolts or rivets, their use was required.

From the statistical reports of the Interstate Commerce Commission, figures covering two five-year periods have been taken and the results compared. These figures show average results for five years immediately preceding and for five years immediately following the issuance of the Commission's order of March 13, 1911, namely, 1906-1910 and 1911-1915. Five-year averages are taken for the reason that more uniform results are thus obtained than could be secured by comparing the figures for single years:

	Average for 1906-1910	Average for 1911-1915	Increase, per cent
Locomotives in service....	55,990	63.365	13
Cars in service..........	2,165.059	2,439,862	13
Cars per train..........	27.2	31.3	15
Tons per train..........	359.3	432.3	20
Tons hauled one mile.....	228,936,078,705	276,882,678,387	21
Employees in train service	294,915	310.590	5

In the first five-year period there were 1,219 employees killed and 15,910 injured while engaged in coupling and uncoupling cars. In the second period the number killed was reduced to 857, a reduction of 30 per cent, and the number injured fell to 14,245, a reduction of 10 per cent. In accidents to employees due to falling from cars and getting on and off cars the results were not so favorable. While the number killed fell from 3,247 to 2,537, a total of 710, or 22 per cent, the number of employees injured increased from 59,006 to 68,179, giving a total increase of 9,173, or 16 per cent.

These figures are significant only as indicating a tendency, and I do not want to be understood as claiming that all the improvement shown is due to the Commission's order. That is perhaps the determining or controlling factor, and because of its existence other factors of safety have been brought into play. It is clear, however, that the tendency is toward greater safety, and while giving full credit to other factors, we are justified in concluding that the laws, through the Interstate Commerce Commission's methods of administering them, are substantially accomplishing the purpose of their enactment.

For many years the Interstate Commerce Commission has distributed thousands of copies of the safety appliance acts and the Commission's orders issued pursuant thereto, and arrangements have been made so that they may be secured in any number at the cost of publication from the Superintendent of Documents, Government Printing Office, Washington, D. C. These pamphlets should be placed in the hands of all employees charged with any duty in maintaining these safeguards if full compliance with all the requirements of the safety appliance acts is to be expected.

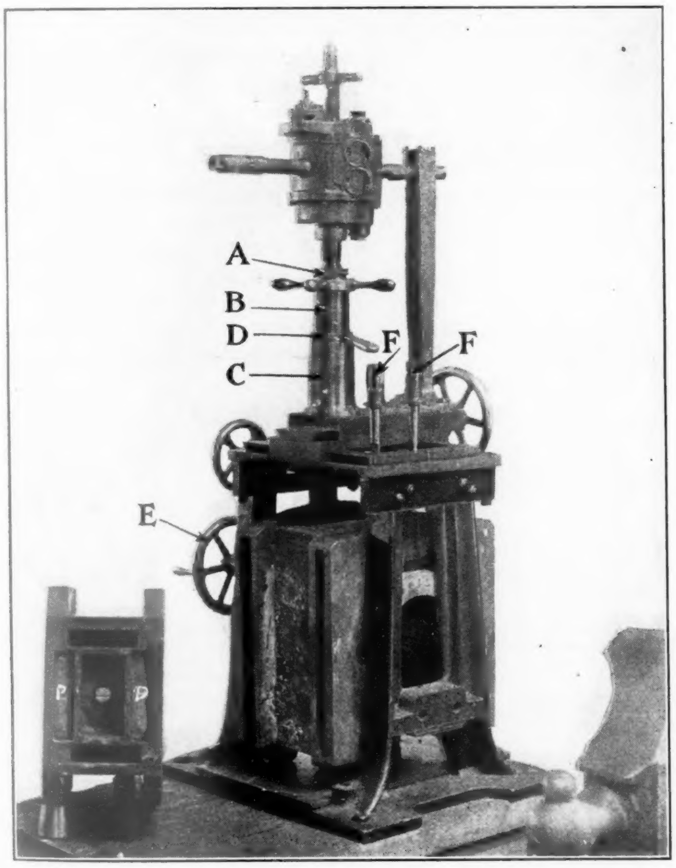
SHOP PRACTICE

DRIVING BOX SPRING SEAT MILLING MACHINE

BY F. W. SEELERT

The photograph shows a simple shop-made milling machine which is used to replace the usual hand chisel and hammer method of finishing the spring seat pockets in the top of locomotive driving boxes.

The frame of the machine, as shown in the photograph, is made up of a number of cast iron parts which were obtained from a scrapped machine tool. Where material of this kind of a suitable nature is not available, a few pieces of heavy boiler plate and structural shapes could be used to equal advantage. On top of the frame is mounted a compound slide, the spindle carrier being rigidly attached to the cross slide.



Improvised Miller for Finishing Driving Box Spring Seat Pockets

The spindle of the machine is shown at *A*. It is mounted on ball bearings in the adjusting sleeve *B*, which is threaded on the outside and screws into the spindle carrier *C*. This provides a simple means of vertical adjustment for the cutter spindle, which may be locked in position when the location of the spindle for the desired depth of cut has been obtained, by means of the clamp nut *D*. The handwheel *E* operates a clamp which closes up against the face of the driving box and holds it securely in position. At *F* are shown two end mills of the type used in the miller. The spindle is operated by means of an air motor, which is held from turning by a vertical arm bolted to the cross slide.

The average time required to finish the two pockets in one driving box by the old method of hand chisel and hammer, was from one to 2½ hours. This milling machine has reduced the time to from 25 minutes to 40 minutes and a much better job is obtained. The machine as shown in the photograph takes boxes up to 12 in. wide. Its total weight is 420 lb.

MILLING MACHINE PRACTICE IN RAILWAY SHOPS

BY C. A. SHAFFER
General Inspector of Tools, Illinois Central, Chicago, Ill.

From a general viewpoint it does not appear that milling machine practice in some railroad shops has been given the attention or consideration that this particular method of machining merits. While there are some progressive shop men who have gone into the details of this class of work and made use of advanced tools and ideas concerning their application and have obtained very good results, there are many places where the field for improvement along this line is large.

The average railroad shop of fair size has in its machine tool equipment, one or more of the horizontal knee type milling machines. They are usually found in the tool room and are used for fluting reamers and taps or machining the shanks of such tools, also cutting shaft keyways and other miscellaneous jobs. In the main shops of large roads will also be found the larger horizontal millers commonly used for surfacing and fluting locomotive rods, machining shoes and wedges, eccentrics, etc., while the heavier vertical type machine is engaged on profiling and other irregular surface work or perhaps milling port openings in valve chamber bushings. There is no question but that modern high duty machines permit of doing more and perhaps better work, but these would be of little use if they were not equipped with the proper cutting tools and in the case of milling machines, regardless of the type, design or age, it is essential that good cutters be used in order to obtain the best results therefrom.

The modern type of milling cutters as now used, in most up-to-date shops, differ considerably from those generally in use but a few years ago, both in design and material. The old style carbon steel cutter with many teeth, narrowly spaced, had to give way to the high speed cutter having few wide spaced teeth. It is hard to realize the advantages these new types of cutters have over the old style until a comparison has been made of the work each will do. The wide spacing permits larger and stronger teeth and better clearance and escape for good large chips, consequently greater feeds can be used. It also lessens the amount of grinding

necessary and the tendency to heat the cutter and work while in operation. It was noticeable, that very soon after the introduction of these coarse tooth type cutters, the leading manufacturers accepted the advanced design and are now showing them in their catalogs. In many of these new design cutters, considerable attention has been given to the spiral and for the various classes of work care should be taken to secure the proper lead, pitch and form of teeth for such cutters.

In the last few years nearly all milling cutters for rapid heavy duty work have been made of high speed steel, the small sizes being cut from solid stock and the large ones usually built with bodies of cheaper material and inserted high speed steel teeth. There is no question but that high speed steel is the proper material for such tools and will continue to be used by exacting mechanics even at the present high price. The necessity for economy in this line however, has caused wonderful development in the design and construction of inserted tooth cutters to fully meet the requirements and which are equal in performance to those made from the solid material.

One of the greatest factors for efficiency in milling is proper lubrication of the cutters. Without some good means of cooling, it is impossible to get near the maximum amount of work out of any design of cutters for the limit of speed is reached when the cutter burns. Therefore, in order to prevent destruction of the tool and to get the most out of the cutters it is necessary that they be kept cool. This is accomplished by the proper application of lubricants and it has been demonstrated that the nature of the lubricant is of minor importance so long as a sufficient quantity is provided. One of the prominent milling machine manufacturers after making exhaustive experiments along this line has developed a very complete system of cutter lubrication, which is featured in connection with its make of machines, special appliances being furnished for the equipment when required. This system provides for a liberal stream of fluid, which is forced upon the cutter through a hood, keeping the cutter cool and also serving to wash away the chips, which adds to the life of the cutter.

The possibilities of milling with helical cutters are very great and many shops are employing this method for cutting blocks from the solid in steel or iron, where formerly the job was done by drilling holes to release the block and then finishing to size on the slotter or shaper. Where proper equipment is used for such work the time is greatly in favor of the milling process and the increasing amount of work being done in this manner bears evidence of the fact. One particularly small job of this character which may be interesting is the milling of keyways in piston rods or cross heads instead of drilling, chipping and filing them. This job may be done on a knee type milling machine but there are some good small portable devices which were recently brought out by the use of which a considerable saving may be effected. A high speed three-tooth helical cutter is used and if driven to capacity will cut keyways in piston rods in from 12 to 30 minutes each, depending upon the size and nature of the material. These rod keyways when drilled and chipped by hand usually take from three to five times longer than when they are done by the milling process.

There are other well known operations in railroad shop work which it is believed could be handled with more economy and satisfaction if a little preliminary time was given to the study and working out of the proper equipment and way to do the job. If one is interested, though doubtful, about some particular operation, which may be done by the milling process, a blue print or a sample of work might be sent to a good manufacturer for a guaranteed time and cost estimate of the job. This may save a lot of experimenting and the machine tool makers will be glad to tell what it will cost and how it can be done.

It is always well to remember the following as essential to good results on the milling machine:

Keep the machine in good condition at all times.

Use arbors of as large diameter as possible to prevent chattering and springing away from the work.

If a rigid intermediate support can be used with a bearing close to the cutter, it will be helpful on heavy duty work.

Use high speed coarse tooth cutters of a design to suit the work and make them produce results by keeping them cool by lubrication when cutting steel. Increase the feed in proportion to the speed of the cutter to the limit of finish required.

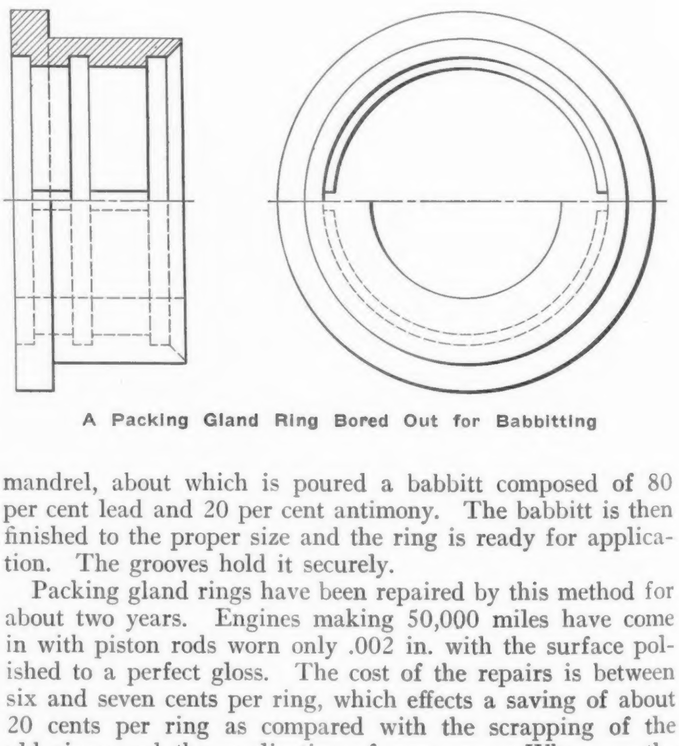
Good cutters will produce more work and stay sharp longer when used under these conditions.

RECLAIMING AIR PUMP PACKING GLAND RINGS

BY WILLIAM K. CLEARY
Air Brake Foreman, Boston & Maine, Lyndonville, Vt.

When air pump packing gland rings become enlarged by wear, they must be renewed or the pump cylinders will be worn unevenly and piston packing will require frequent replacement.

In order to avoid scrapping the packing gland rings, the following method of repairing them has been adopted by the writer. The old rings are first bored out to an inside diameter of 1⅝ in. and then three grooves are turned on the inside of the ring, each 1/16 in. deep. Two grooves are then cut longitudinally to the same depth. The rings are then placed flange down, on a smooth surface and a taper plug placed in the center of the bore to form an easily removed



A Packing Gland Ring Bored Out for Babbitting

mandrel, about which is poured a babbitt composed of 80 per cent lead and 20 per cent antimony. The babbitt is then finished to the proper size and the ring is ready for application. The grooves hold it securely.

Packing gland rings have been repaired by this method for about two years. Engines making 50,000 miles have come in with piston rods worn only .002 in. with the surface polished to a perfect gloss. The cost of the repairs is between six and seven cents per ring, which effects a saving of about 20 cents per ring as compared with the scrapping of the old rings and the application of new ones. Whenever the repaired rings become worn, it is only necessary to melt out the old babbit and reline them to continue them in service.

INCREASED USE OF FUEL OIL.—According to statistics issued by the United States Geological Survey, 5,477,951 barrels, or 15 per cent more fuel oil was used in 1916 than in 1915. The average distance covered by a locomotive per barrel of fuel oil consumed was 3.33 miles.

ROD WORK ON THE CHESAPEAKE & OHIO

Second Prize Article in the Rod Job Competition. Organization and Methods for Handling Rods Described

BY H. M. BROWN
Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

THE Huntington shops of the Chesapeake & Ohio are well equipped to handle rod work. The machines are so located that a progressive system of operation is obtained, no delay being encountered in passing the rods from one machine to another until they have been completed. This enables the work to be done at a lower cost than if

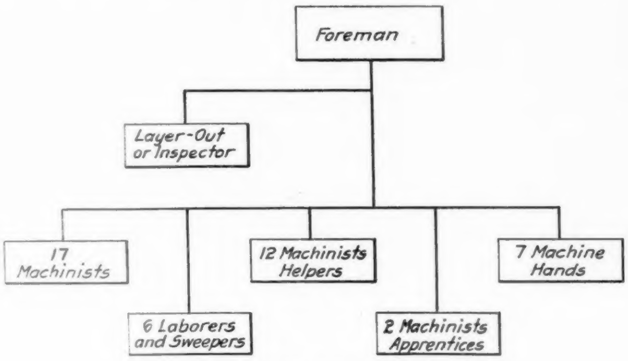


Fig. 1—Organization of the Rod Gang

the machines were placed indiscriminately throughout the shop as the rods do not have to be handled as much. The machine tools employed in the rod work are of the latest design and are particularly adapted to this work.

The organization of the force for handling this work is shown in Fig. 1, and the arrangement of the machine tools

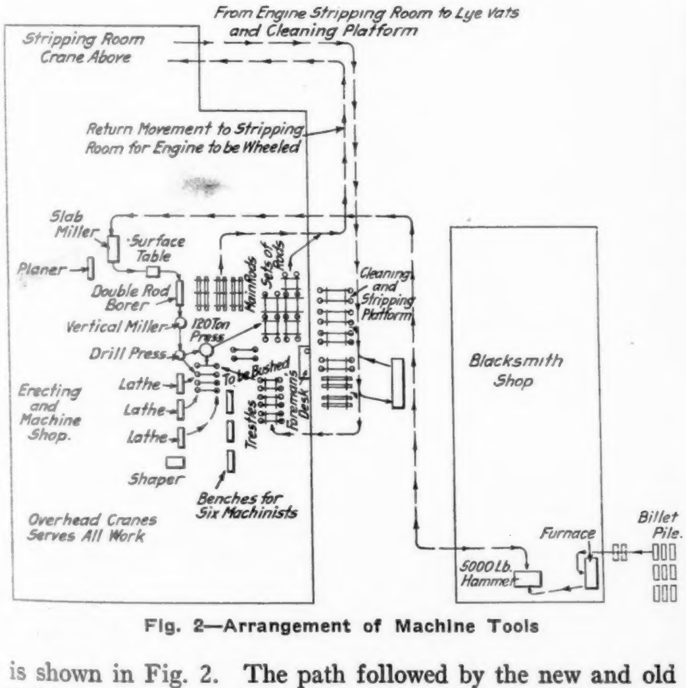


Fig. 2—Arrangement of Machine Tools

is shown in Fig. 2. The path followed by the new and old rods as they pass through the shops is indicated by the arrows. The new rods start from the billet pile just outside the smith shop, and end at the stripping room, where they are placed on the locomotives. The old rods start and end at the stripping room as shown. They are cleaned in a lye vat, of course, before they go into the shop.

The benches are arranged longitudinally and are made separate, so that two machinists are enabled to work on each side of the bench. Below the benches are drawers and suitable cupboards to take care of the tools of the machinists,

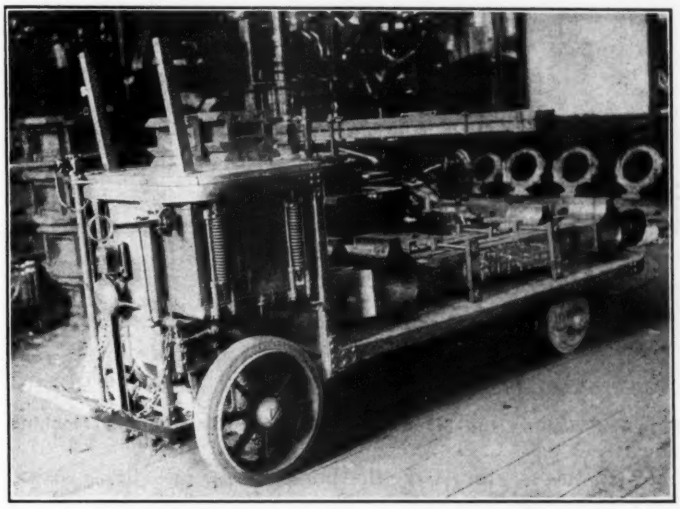


Fig. 3—Motor Truck for Carrying Rods About the Shop

as well as parts for rods that are undergoing repairs. The cleaned and stripped rods, as well as new rods are stored on benches directly behind the lathes used for turning the bush-

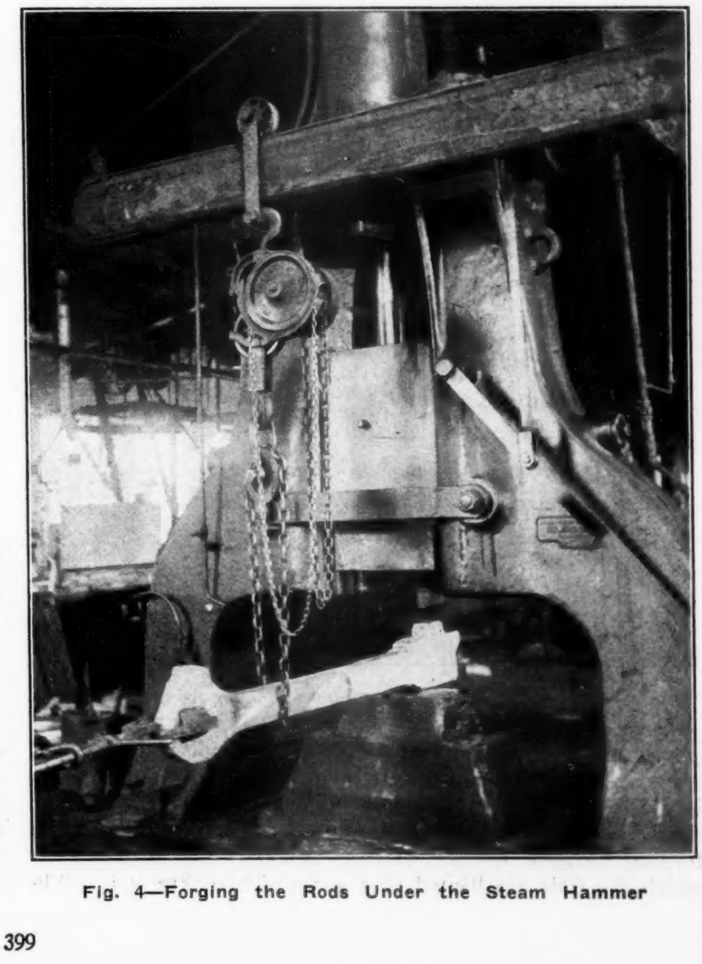


Fig. 4—Forging the Rods Under the Steam Hammer

ings and the shaper for machining front and back end main rods. The cleaned and stripped rods, as well as new rods, are stored on benches directly behind. On all repair work the size of the pins is obtained by the mechanic, who calipers all axles for turning. He delivers the sizes of the axles to the machinist on the boring mill, and the sizes of the pins are delivered to the machinists on the lathes. With this method it is not necessary for these mechanics to lose any time whatever in getting sizes.

Fig. 5—Finishing the Sides of a Rod on a Slab Milling Machine

A motor truck, shown in Fig. 2, is used for carrying the rods from one shop to another and between the machines, where it is necessary. This truck is capable of carrying two tons and gives excellent service with little expense and practically no delay.

The new rods are made directly from billets which are purchased in the open market under physical and chemical specifications made by the railroad company. As an order is placed the blacksmith shop foreman selects the proper sized billets. The billets are taken from the pile to the forging furnace by the electric truck. The furnaces in which the rods are heated uses gas which makes it possible to easily control the temperature and maintain it at a more uniform degree than when either coal or oil is used. The billets are brought to the proper temperature slowly, but at a sufficient speed so that at no time will the billets slough. The proper temperature is determined by a colored glass scale supplied by the United States Bureau of Standards.

Fig. 6—Boring the Rods on a Double Spindle Boring Machine

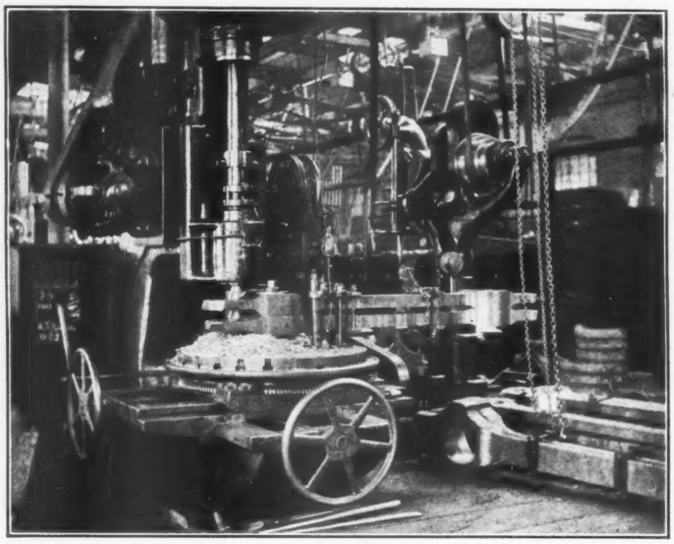


Fig. 7—Milling the Ends of the Rods

The billets are then forged to a template under a steam hammer as shown in Fig. 4. The actual time from the receipt of the billet at the blacksmith shop until it is forged to shape is eight hours. After the rods have been forged they are set aside and just before the shop closes at night, they are put back into the furnace and allowed to anneal with the cooling of the furnace and in this way relieving all

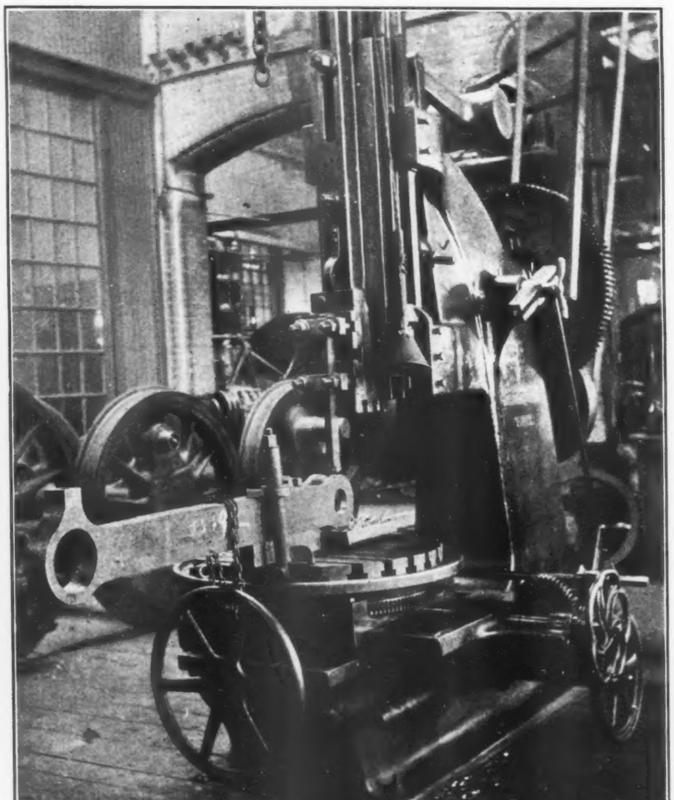


Fig. 8—Slotting the Rods for the Knuckle Joint Connection

hammer strain. They are removed from the furnace the following morning and delivered to the machine shop by the electric truck. They are allowed to cool throughout the day and night, not being machined until the next morning.

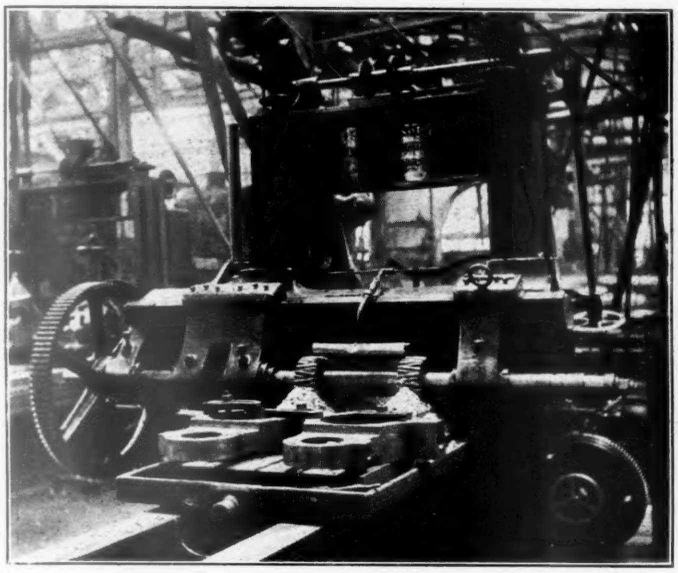


Fig. 9—Fluting the Main Rods

The first machine work to be done is to mill the sides of the rod. This is done on a slab milling machine as shown in Fig. 5. Both the center and ends are milled. On account of the grease cups which are forged on the rods, it is impossible to get more than one rod on this particular machine, except when the rods are being fluted, where it is possible to allow the grease cup to extend over the side of the machine. After the rods have been milled to size, they are paired and laid off according to a template. From there they pass to the double spindle rod boring machine shown in Fig. 6, the paired rods being bored for the brass fit and the knuckle pin bushing. An adjustable boring tool is used for boring the holes in the rod.

After the rods have been bored, the oil cups and knuckle pin oil cups are drilled, faced and tapped, a skip thread tap being used for this purpose. The ends of the rods are milled in pairs as shown in Fig. 7. The jaw in the end of the side rod for the knuckle connection is made on a slotter as shown in Fig. 8. Fig. 9 shows the method of forming the channels in the rods on the same slab milling machine shown in Fig. 5.

The actual cost of labor and material for finishing a pair of middle connection rods complete for a heavy Pacific type locomotive is $156.77. The front end and back end of the side rods are handled in pairs in the same manner as described above with the middle connection rods. The cost of manufacturing from the billet to the finished main rod is $254.57, while the complete cost for a complete set of rods on a heavy Consolidation locomotive is $624.88, including the brasses.

Interesting Back Shop Performance

Consolidation Locomotive Given General Repairs and External Boiler Inspection in 33 Hours on the D. & H.

THE Delaware & Hudson, at Colonie, N. Y., made an interesting performance a short time ago in putting a locomotive of the Consolidation type through the shop for general repairs in 33 hours. It was one of a class that was in considerable demand, and in this particular case it was desired to turn the engine out with the least possible delay. In addition to the usual general overhauling, the locomotive was due for its five-year external boiler inspection as required by the Federal government; this requires the complete removal of the lagging.

The locomotive is used in freight service on the Pennsylvania division and is of the following general dimensions:

General

Gage	4 ft. 8½ in.
Service	Freight

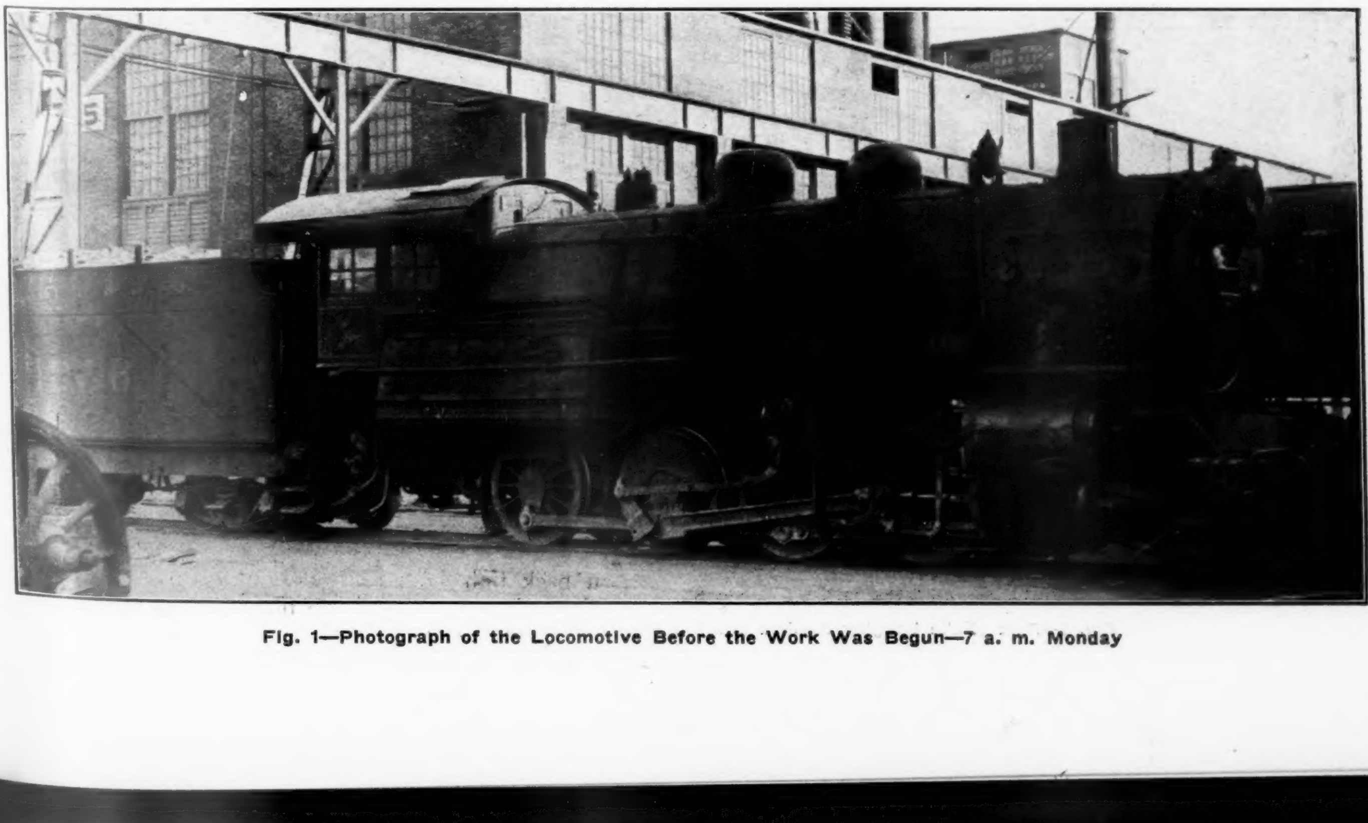


Fig. 1—Photograph of the Locomotive Before the Work Was Begun—7 a. m. Monday

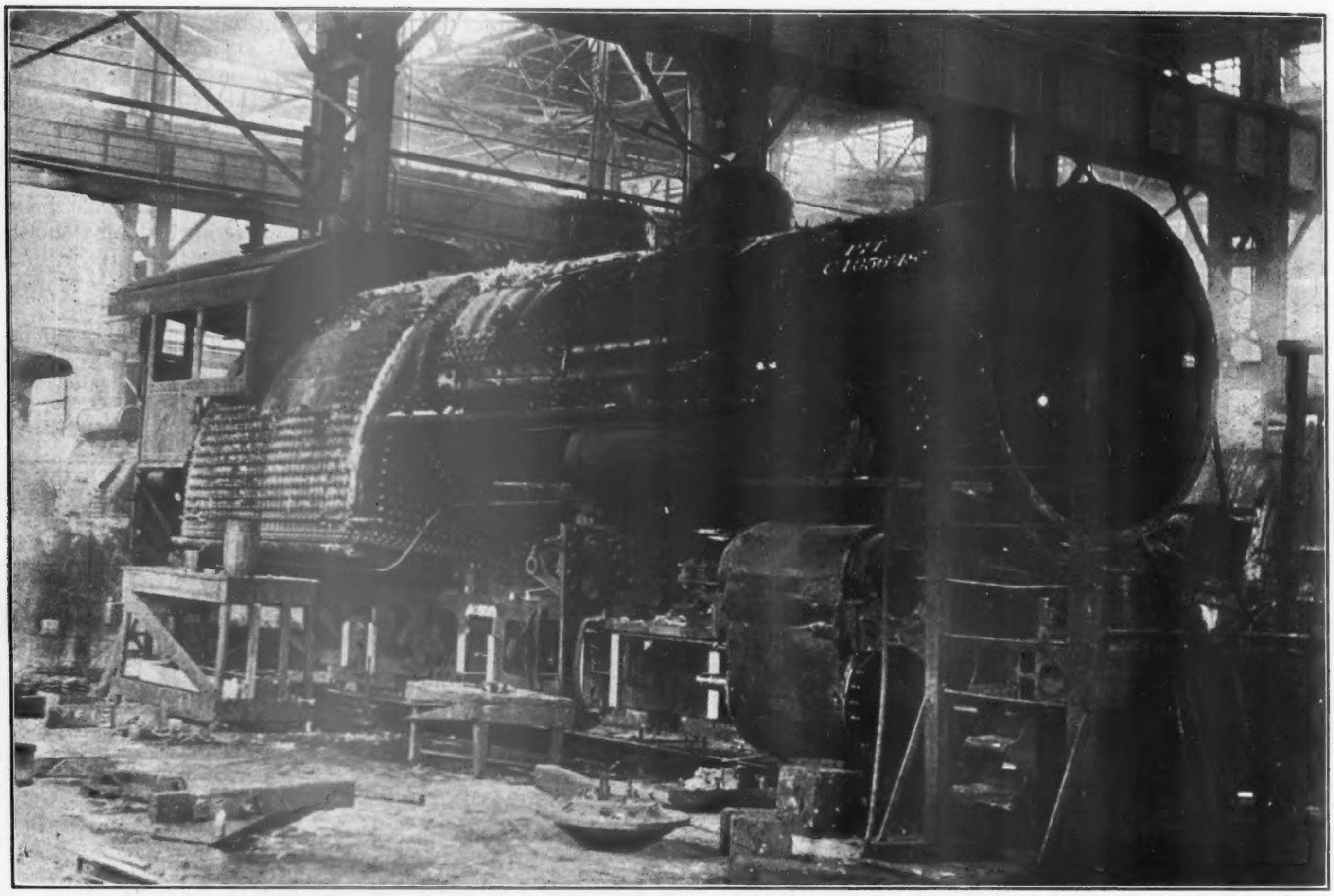


Fig. 2.—Photograph of the Locomotive Two Hours after the Work was Begun.

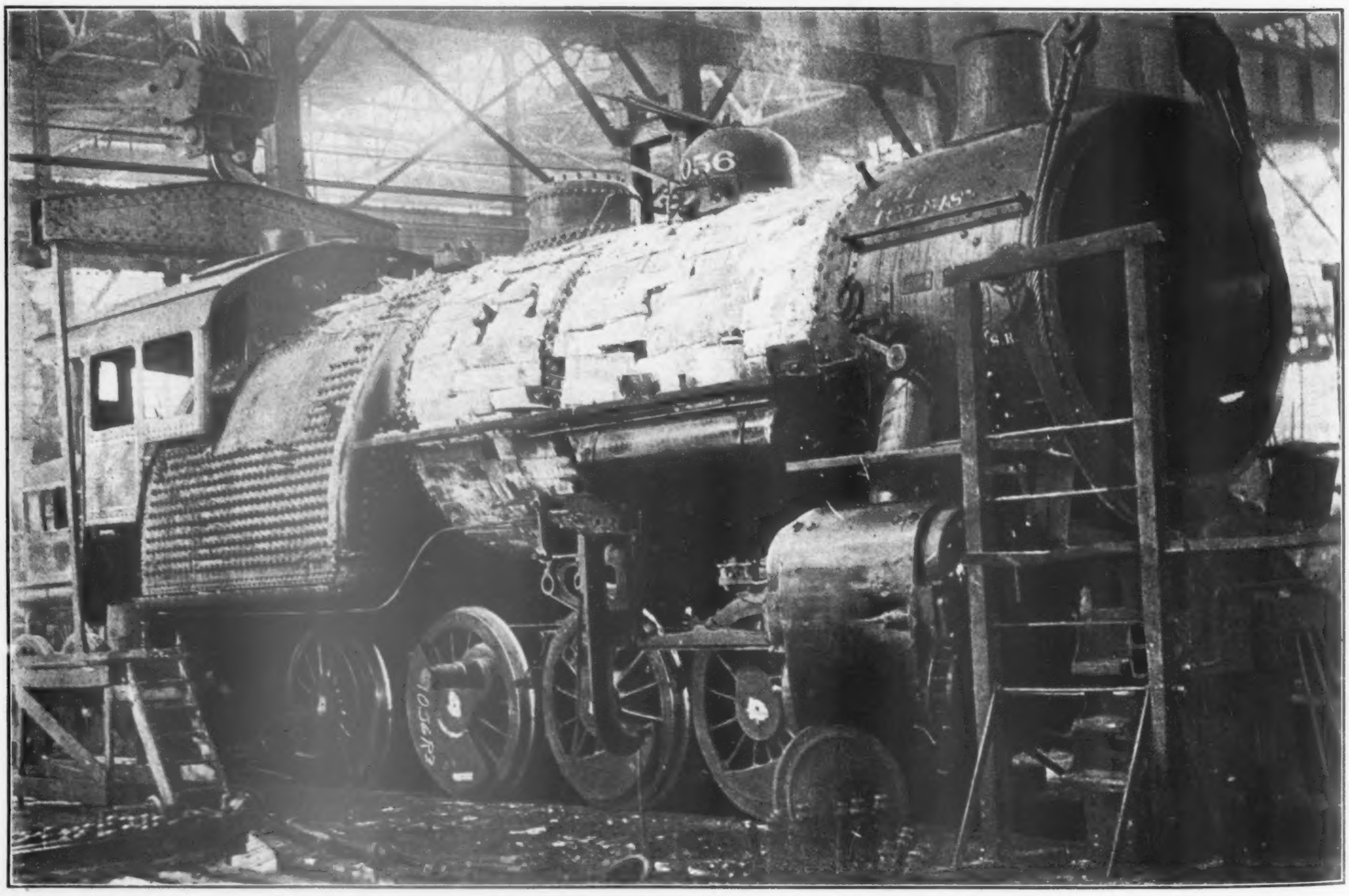


Fig. 3—Part of the Lagging Applied and the Engine Wheeled at 1 P. M. Monday.

Fuel	Anthracite
Tractive effort	56,900 lb.
Weight in working order	257,050 lb.
Weight on drivers	231,550 lb.
Weight on leading truck	25,500 lb.
Weight of engine and tender in working order	389,417 lb.
Wheel base, driving	17 ft.
Wheel base, total	26 ft. 1 in.
Wheel base, engine and tender	63 ft. 1½ in.
Cylinders	
Kind	Simple
Diameter and stroke	25 in. by 30 in.
Wheels	
Driving, diameter over tires	57 in.
Driving journals, main, diameter and length	11 in. by 17 in.
Driving journals, others, diameter and length	10 in. by 13 in.
Engine truck wheels, diameter	30 in.
Boiler	
Style	Wootten
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	82 in.
Firebox, length and width	126⅛ in. by 114 in.
Tubes, number and outside diameter	275—2 in.
Flues, number	38
Tubes and flues, length	14 ft. 6 in.
Grate area	100 sq. ft.

The locomotive was received at the shop cold on a Monday at 7:00 a. m., as shown in Fig. 1, the photograph being taken on the wash track. The following is a schedule of the principal work that was to be done on it:

- Full jacket and lagging removal
- Tate caps removed of which there were between 1,200 and 1,300
- Superheater flues removed
- Small tubes rolled and prossered
- New shoes and wedges
- New driving brasses
- Tires turned
- Lower guides planed and ground
- Crosshead rebabbitted
- New rod brasses
- Main and side rods and drawbar annealed
- Air brake equipment overhauled
- Throttle ground

The next picture of the locomotive was taken at 9:00 a. m. of the same day, and is shown in Fig. 2. Between seven and nine o'clock the boiler front and the netting had been removed, the locomotive was completely stripped, the lagging and jacket were removed entirely, the wheels were dropped, the superheater units removed and the boiler was ready for the first test. The valves were also out, the bottom guide bar removed and new shoes and wedges were applied ready to be laid out. Immediately after the superheater units were removed, the work of removing the large superheater flues was begun. The locomotives in the district in which this locomotive operates usually have but very little difficulty with scale in the boiler, but on this particular engine the superheater flues were so scaled that it took until 6:35 p. m. to remove the entire thirty-eight.

The third picture was taken at 1:00 p. m. on the same day, and is shown in Fig. 3. It will be observed that the boiler has part of the lagging applied. The spring rigging was also reapplied. The boiler had been given its test and the wheels applied. The wheels were placed under the engine during the noon hour at a time when the least disturbance would be caused to the rest of the workmen and the crane could be spared best. This work is usually done by the night shift. The practice at this shop is to provide a full set of spring rigging for application to the locomotives as they pass through the shop.

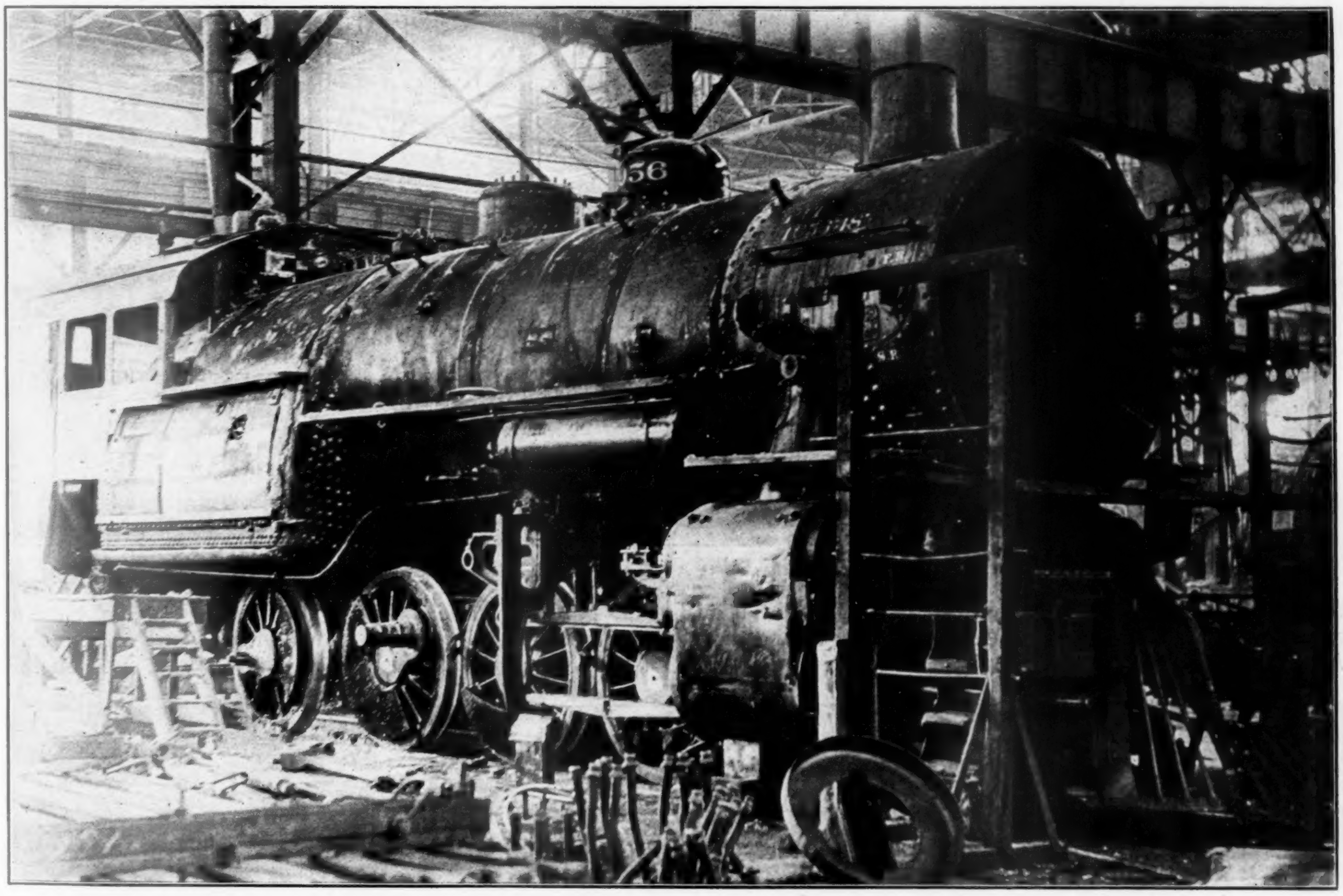


Fig. 4—The Locomotive at 5 P. M. Monday

The locomotive as it appeared at 5:00 p. m. on this same day is shown in Fig. 4. The lower guides are back in their place, having been planed and ground, the lagging has been applied and the jacket is in place. The heads of the Tate staybolts have been removed and replaced, and all the staybolts examined. As stated above, the flues were removed at 6:35 p. m. The new ones were applied complete in 1 hour and 25 minutes after the old ones had been removed. During the night the superheater ball joints were ground and units replaced. The front end netting was put in position, the side rods were hung and a large amount of the piping

was reapplied. The crosshead and cylinder heads were applied. The appearance of the engine at 7:00 a. m. on Tuesday is shown in Fig. 5.

The rest of the work was done between 7:00 a. m., when the day force again took the engine, and 12:30, at noon, when it was finished complete, fired up for the testing crew. As will be seen from a close examination of Fig. 5, the work done during this period consisted of applying the main rods, applying the motion work, crank pins, extension piston rods, crossheads and guides, cab fittings, brake connections, pops, etc. The valves were squared by moving the locomotive by a smaller engine. The boiler was washed out and was filled with hot water and fired up in about 30 minutes. The engine was in the hands of transportation department at 4:00 p. m. on Tuesday, just 33 hours after it was received at the shops. The photograph shown in Fig. 6 was taken when it left the shop. The regular shop forces were used on this engine and a little overtime was paid to get the engine out as soon as possible, but with the night force, which is common to this shop, very little overtime was required.

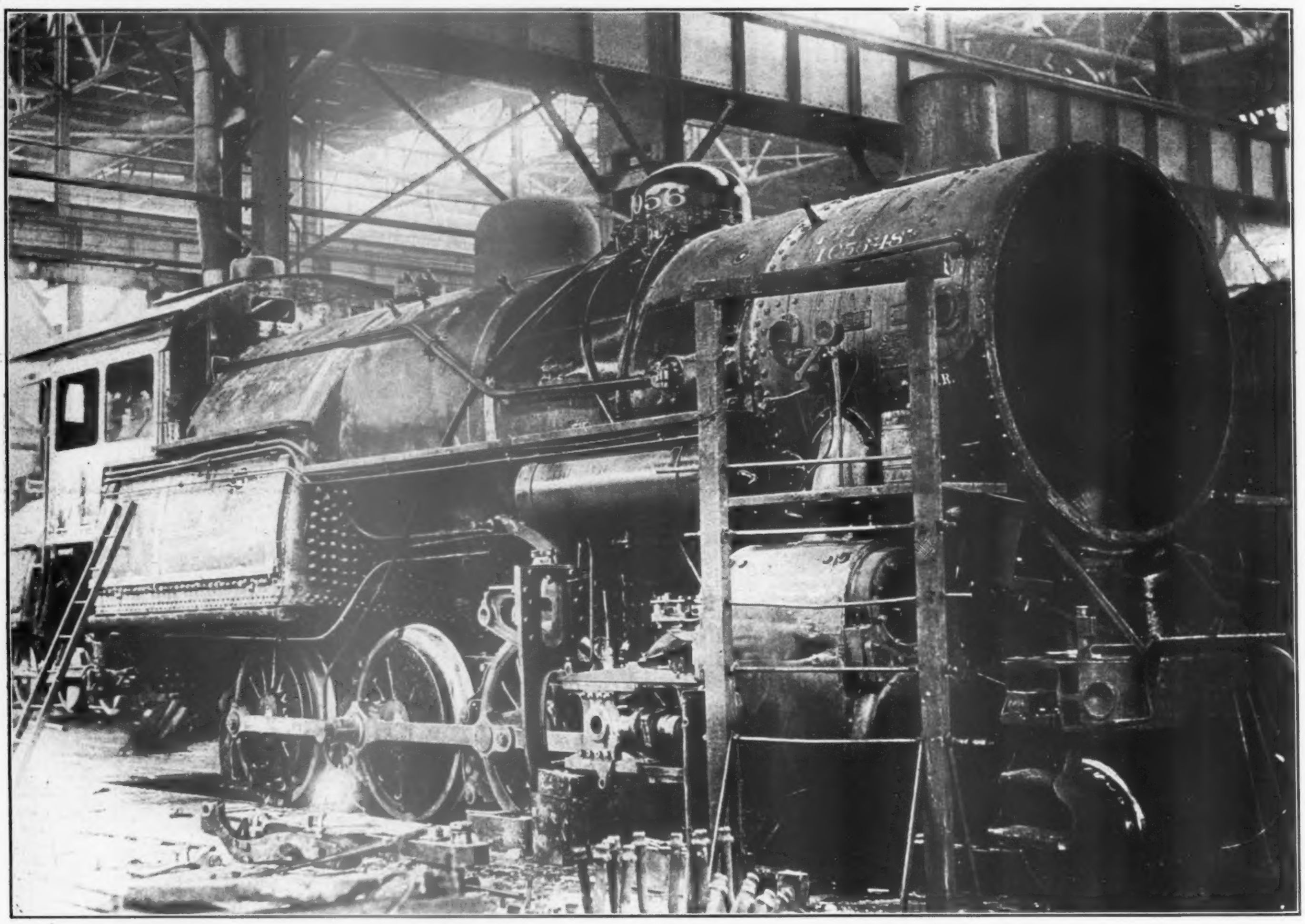


Fig. 5—The Locomotive as It Appeared at 7 A. M. on Tuesday.

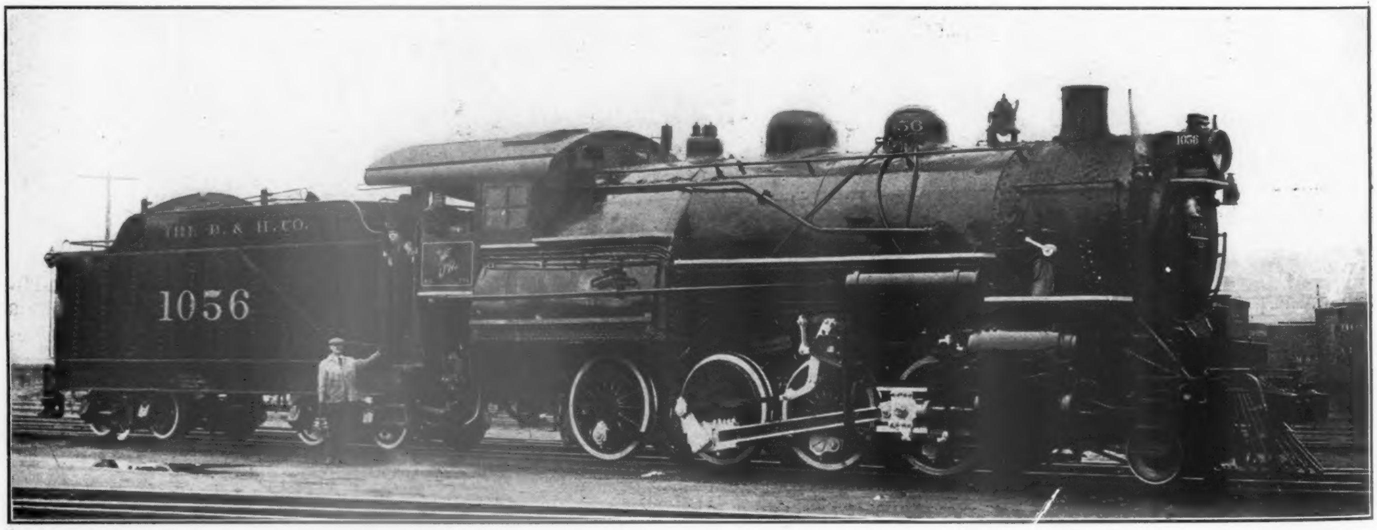


Fig. 6—Locomotive Ready for the Transportation Department at 4 P. M. Tuesday.

The practice at this shop is to have as much of the material as possible ready for a locomotive before it comes to the shop. An advance report is submitted for every locomotive so that the material will be ready for application. The shoes and wedges and the spring rigging are made up in advance from new material so that they can be applied immediately. A shop schedule system is used in this shop. The performance described above is a very special case, as it was desired to release the engine as promptly as possible. Preparing material for application in advance has helped a number of shops on other roads to considerably cut down the time that locomotives are in the shop.

HANDLING ROD REPAIRS*

BY JAMES GRANT
Great Northern, St. Paul, Minn.

The rod department of the Dale Street shops, St. Paul, of the Great Northern, is located in a building entirely separate from the machine and erecting shop. It adjoins the wheel or stripping shop, and a gang of machinists consisting of four bench hands, five machine hands, one machinist apprentice and one helper constitutes the force. One of these machinists supervises the work and is called the "leading hand." These shops turn out an average of 35 locomotives per month, and this gang handles the rods for all of them.

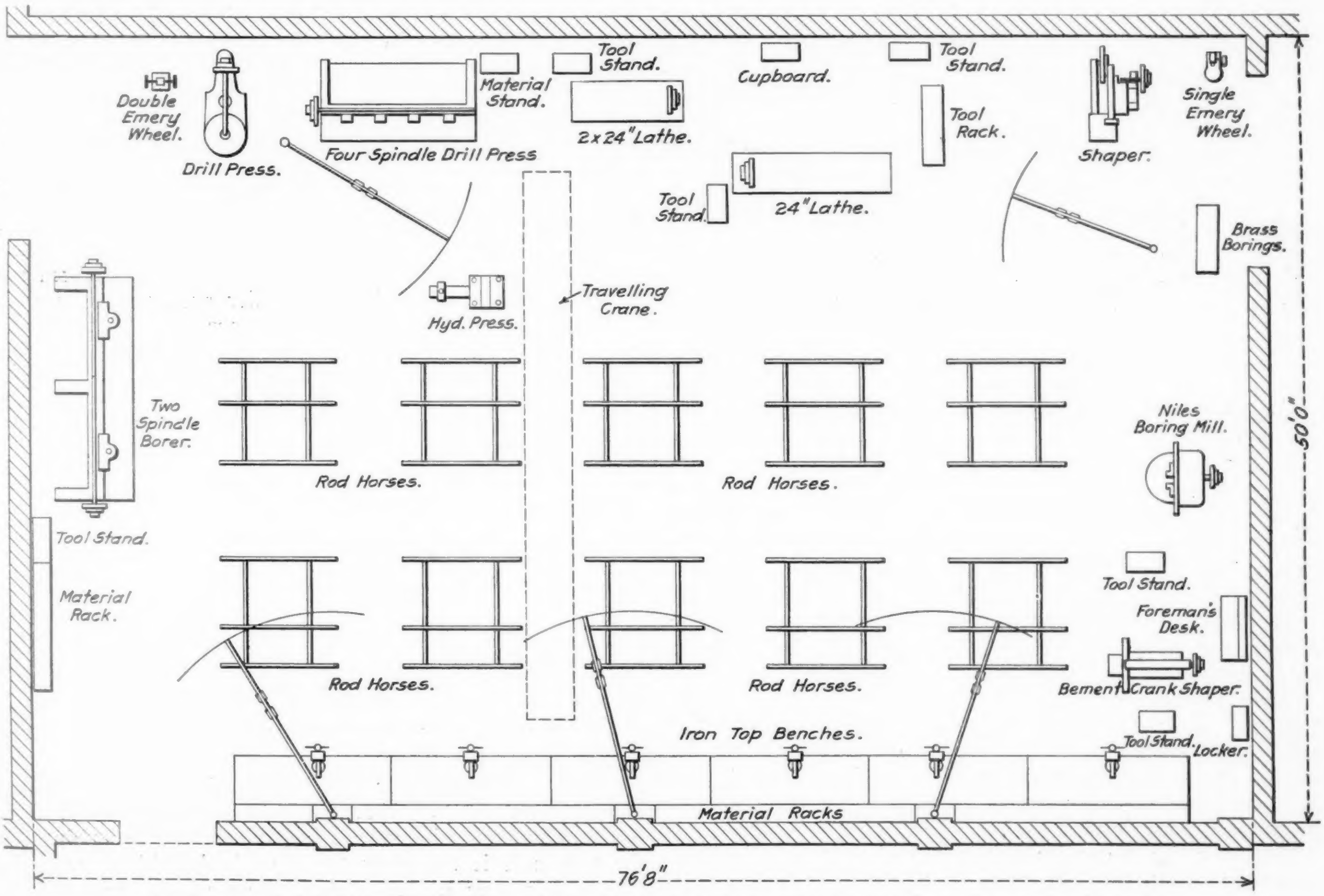
The following machines are located in the rod shop: One Newton 2-spindle rod boring machine, one 20-in. by 2½-in. double emery wheel, one 42-in. Niles vertical boring mill with two heads on the cross rail, one 26-in. Morton draw cut shaper, one 2-in. by 24-in. Jones & Lamson turret lathe, one 13-in. column shaper, one 4-spindle drill press, one Lodge & Shipley engine lathe with a 24-in. swing and a 10-ft. bed, and one 50-ton hydraulic press. These machines enable the rod gang to do practically all its own machine work, thus making it an independent unit from the machine shop.

* Awarded third prize in the Rod Job Competition which closed May 1.

Locomotives coming to these shops for repairs are first stripped in the wheel or stripping shop. The rods are then cleaned and trucked into the rod shop, where they are stamped for identification and examined for any defects. It is a standing practice on this road to anneal all rods when an engine goes through the shops, so after all the brasses and bushings have been removed, the rods are trucked to a large annealing furnace located in the boiler shop, which also adjoins the rod shop.

After being annealed the rods are brought back to the rod shop for repairs. If a rod brass strap is found to be worn above the standard size, it is taken to the blacksmith shop and closed just enough so that it can be machined again to the standard dimensions. This practice always keeps the straps to a standard opening, so that when a brass is to be replaced outside the main shop, a new one can be readily obtained through the storehouse properly machined and practically ready to apply. This is a great help at small roundhouses, which have not got the machine facilities. Many roads just fit the brasses to suit the straps irrespective of whether the strap fit is worn to larger than the standard dimensions. In this case, when a brass is changed, it is often found necessary to insert a liner in order to keep the brasses tight in the strap. All rods are very carefully examined after annealing for any signs of cracks or warping.

All machine work pertaining to rod overhauling is done in the rod department, with the exception of making the crosshead pins. This work is taken care of in the machine



Arrangement of Machine Tools for Rod Work at the Dale Street, St. Paul, Shops of the Great Northern

shop. If it is found necessary to true up the knuckle pin or bushing holes, this work is done in the rod boring machine, and special care is taken to always keep exact centers. Rod bolts are all machined in the Jones and Lamson turret lathe, and all bushings are machined in the vertical boring mill working both heads, turning and boring the bushing at the same time. The bushings are pressed in by hydraulic pressure.

The first operation in machining the brasses is to take a cut from both halves. They are then sweated together in order to facilitate machining. The strap fits are made on the draw cut shaper. The brasses are then fitted in the strap, which is bolted on its own rod, and securely keyed in position. The operation of boring and facing is then performed on the rod boring machine and is completed with one setting. This is considered to be the only perfect way to bore brasses, as it eliminates any danger of a twist and keeps the bore at each end of the rod in perfect alinement. The front and back end main rod brasses are handled the same way.

No brasses are scrapped if they are found still to be in condition for further service. Sometimes all that is needed is to take up a little lateral, which is done by riveting on a brass liner. This reduces them enough to allow for reboring. They are always put in the rod and bored and faced on the rod boring machine. It is quite a common habit for machinists to scrap all brasses and order an entire new set every time an engine goes to the shop, thereby, entailing a lot of unnecessary expense. The leading hand in this department examines all old brasses and determines if it will be profitable to use them again.

When all the machine work has been done and the bolts and wedges have been properly fitted, the whole set is put together with knuckle pins applied and are carefully trammed. If a rod is found to be long or short, this defect is remedied before leaving the department. Every rod must tram to gage, and the length over the entire set must be exactly to standard dimensions. After carefully checking the rods, they are then taken down and are ready to apply to the locomotive. The rods are applied by the gangs on the erecting floor, as the rod men never leave their own department. All crank pin sizes are brought to them, and everything is worked to gage as near as possible. A keeper screw is applied in all rods to prevent the bushing from turning in the event that it works loose, thus always ensuring lubrication from the grease cup.

All the grease cups are carefully gone over and overhauled by the rod department also, and care is taken to see that proper grease channels are made in order to lubricate the crank pins.

When the rods are all set up to standard lengths it is unnecessary to trouble with "spotting" and "plumbing" the crank pins when the rods are applied, and they can be slipped on in most any position. If they don't connect then the locomotive is either out of tram or there is something wrong with the pins.

New rods for the entire system are also handled by this department. The machine work on new rods is done in the machine shop, where the slab and vertical millers are located, but all laying out, fitting up, and boring brasses and bushings for these rods is done in this department.

While the foregoing methods may not be the least expensive for handling rods, it is considered to be one of the most thorough and practicable. Rod trouble is one of the smallest sources of worry on this road, and care in overhauling them certainly is a decided factor towards eliminating these troubles.

LIBERTY LOAN SUBSCRIPTION.—In the recent drive for the purchase of Liberty bonds, 73 per cent of the men in the Colonie shops of the Delaware & Hudson subscribed.

RECLAIMING CAST IRON WHEELS

Chilled iron wheels with slid flat spots are now being reclaimed with success on one of the large western roads by grinding the tread of the wheel until the flat spot is ground out. During the past year the price of chilled iron wheels has advanced approximately 80 per cent and the differential per pair of wheels is now more than $6. As the cost of grinding is less than 60 cents a pair the method effects a very large saving.

Before the practice of grinding car wheels was adopted an investigation was made to determine the average depth of chill in the wheels. The inspection showed that it varied widely and instructions were issued that the wheels made by certain manufacturers were not to be ground as it was found that the depth of chill was not great enough to permit it. At the present time system wheels with flat spots up to 3½ in. in length are ground, and wheels of foreign roads with flat spots up to 3 in. in length. The longest flat spots are ground out of the wheels which are comparatively new and of the smaller tape sizes, since the small wheels always have the greatest depth of chill. The average chill of a good quality wheel is usually about ½ in. and since a flat spot 3½ in. long represents a depression of only .095 in. from the normal contour of the wheel it will be seen that a considerable depth of chilled metal remains after grinding. It has been found difficult to determine the original tape size, since the painted marks are often obliterated and at the present time all wheels for this road are cast with five projections and the tape size is shown by chipping off some of them.

No wheels having shelled out spots or with tread which has been brake burnt are reclaimed. Wheels which are suitable for grinding are shipped to the nearer of the two points on the system where the grinding machines are located and after being ground are placed under system cars at those points. In order that the performance of the wheels may be watched after grinding the place where the work is done and the date are stamped on the plate of the wheel. From one to two hundred pairs of wheels are reclaimed every month and the records show that a very good performance is secured from them after grinding. Since each pair is exactly mated and there is no eccentricity in the wheels which have been ground the tendency toward flange wear is less than in the case of new wheels.

The cost of reclaiming wheels by this method is in detail as follows:

Interest, depreciation and repairs to machines, per pair	5 cents
Power per pair, at 1½ cents per K.W. hour	15 cents
Grinding wheels, per pair	12 cents
Labor and pro rata, per pair	25½ cents
Total	57½ cents

The life of the abrasive wheels used on this work varies somewhat. The number of wheels which each one grinds ranges from 100 to 175, the average being about 125. Since car wheel grinders are located at only two points on the system it is necessary to ship wheels which are to be reground greater distances than those which are renewed. No reference to this extra cost has been made above as it is offset by the fact that when the wheels are reground it is not necessary to press them off the axles and rebore and remount them, as is the case when new or other wheels are applied.

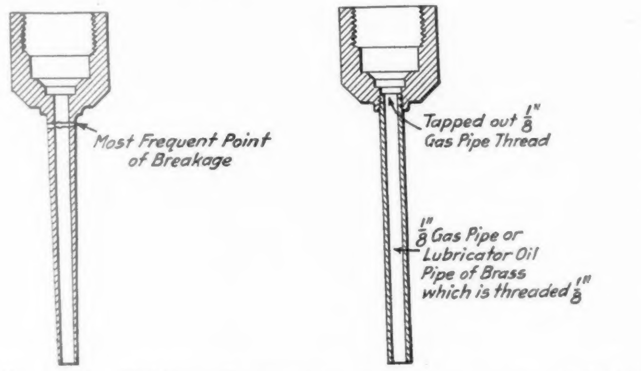
FLAWLESS AND HOMOGENOUS STEEL CASTING.—A 60-in. rotor weighing 10,000 lb., which was recently installed in a large ocean-going yacht as part of a Sperry gyroscopic stabilizer, was made of cast steel. So perfectly was the steel cast that after machining it was found that no balancing was required.

EMERGENCY INJECTOR REPAIRS

BY F. W. BENTLEY

Not long ago the steam valve and priming nozzle of a No. 11 Nathan non-lifting injector was found to be broken on a locomotive which was about to leave the roundhouse at a small engine terminal where no spare parts were available for making the repairs.

The size of the steam opening through the nozzle and valve



Method of Making Emergency Repairs to an Injector Priming Nozzle

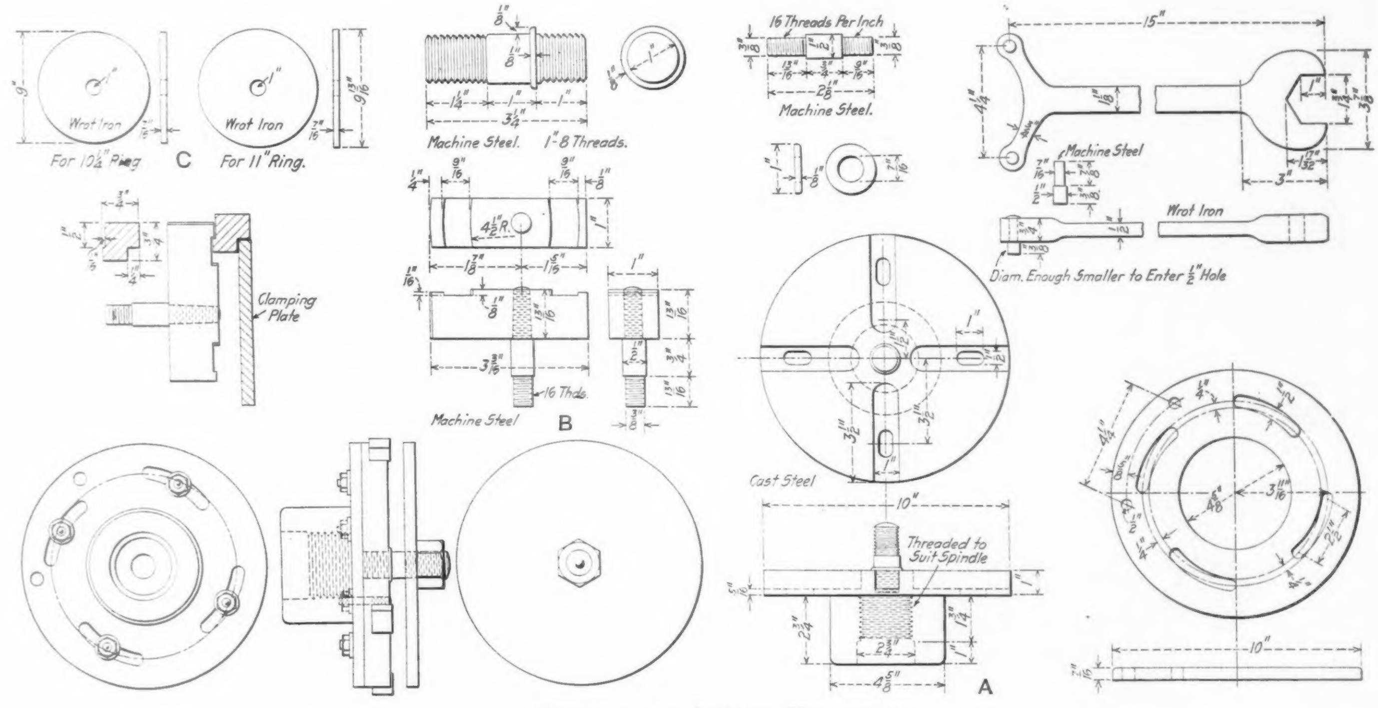
is such that the hole may very readily be tapped out with a ⅛-in. pipe tap. A piece of ⅛-in. brass oil pipe from an emergency lubricator was cut to length and after tapping out the body of the broken valve was screwed firmly in place. Although a new part was ordered, the improvised nozzle end is still in service and is performing very satisfactorily. The repairs were made in a very few minutes with tools that are almost universally available. At small points where the stock of repair parts is necessarily small, this method of repairing these broken parts is entirely satisfactory for use in emergency.

THE CEMENT GUN.—It is reported that the cement gun has been used with very satisfactory results for the application of a cement lining 1¾ in. thick to the interiors of five large steel stacks built for the Ford Motor Company.

CHUCK FOR FINISHING PISTON VALVE PACKING RINGS

The drawing shows the details of a chuck which was designed by T. B. Baldwin, superintendent of shops, New York, Chicago and St. Louis, at Conneaut, Ohio, for finishing piston valve packing rings with diameters 10¼ in. and 11 in. The rings are first roughed out and sawed before being finished in the chuck.

The base of the chuck is shown at *A* and may be designed to fit any lathe spindle. It is provided with four radial slots through the bottom of each of which is an oblong hole ½ in. wide by 1 in. long. A stud is tapped into the center of the plate. The clamping jaws are shown at *B*. These are placed in the slots in the chuck's base with the ½-in. studs passing through the holes in the bottom of the slots and are held in place by nuts on the end of the studs. The adjustment of the jaws is effected by means by a 11/16-in. steel disk, having four eccentric slots through its base. This is placed against the back side of the base plate with the jaw studs extending through the eccentric slots. The adjustment is obtained by turning the plate about the spindle boss on the back of the base of the chuck, two ⅝-in. holes in the plate being provided to fit a spanner wrench shown in the drawing. With the ring in place in the jaws, as shown in the sectional sketch, the clamping plate *A* is placed over the stud in the center of the base and after the ring has been tightly closed by closing in the clamping jaws, the plate is



Details of the Packing Ring Chuck

drawn down tight with the nut on the spindle stud. After the jaws have been properly adjusted, the nuts on the back of the adjusting disk are drawn up tight.

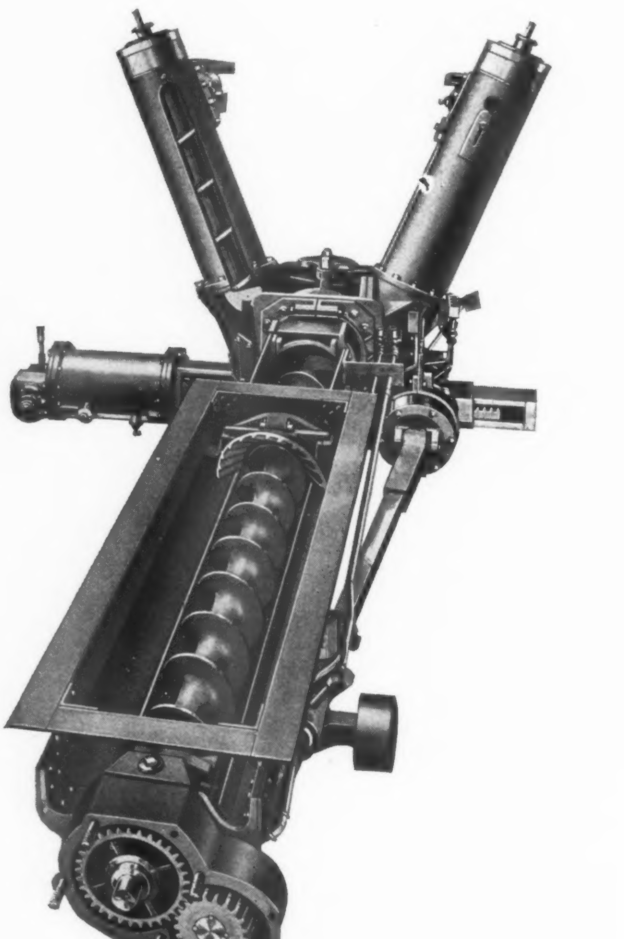
CANADIAN RAILWAY FUEL.—It is expected that the coal bill of the Canadian railways will show an increase of more than $8,000,000 this year. One purchasing agent is quoted as saying that the increase in the price of railway coal will range from 75 to 150 per cent over last year's price. In addition, the Canadian lines must carry a burden in the form of a 7½ per cent duty on the coal imported. A very large proportion of the coal used on the Canadian railways must be bought from the United States.—*The Engineer* (*London*).

DUPLEX LOCOMOTIVE STOKER

A new type of mechanical stoker which is designed to extend the field in which such devices can be used has been placed on the market by the Locomotive Stoker Company, Pittsburgh, Pa. This stoker, which is known as the "Duplex Type D," includes many features of the Street Type C stoker, and, in addition, has a crusher which will handle lump coal, thus doing away with the necessity of specially prepared coal for stoker engines. It is claimed that the crusher will handle the hardest of hand fired coal, reducing it to the proper size before delivering it to the firebox. It will also handle slack coal as well as lump. The stoker occupies little space in the cab and is practically noiseless. Like the Street, it does not take up any of the grate area, nor does it obstruct the firedoor.

Cab View of a Locomotive Equipped with the Duplex Stoker

The Duplex Type D stoker consists of a conveyor and crushing system, an elevating system and a distributing system, the entire mechanism being driven by a simple reversing engine. The travel of the coal through the stoker is as follows: The shoveling sheet is provided with an opening 18 in. wide extending from the coal gates to the slope sheet of the tender. The opening is covered by slides, each measuring about 20 in. in length. After passing through this opening to the trough beneath, the coal is conveyed by the conveyor screw through the crusher, where it is forced against the crusher plate by the screw and broken to a suitable size. The coal is then carried to the transfer hopper, where it is divided equally or unequally according to the position of the dividing rib between the two elevators. In



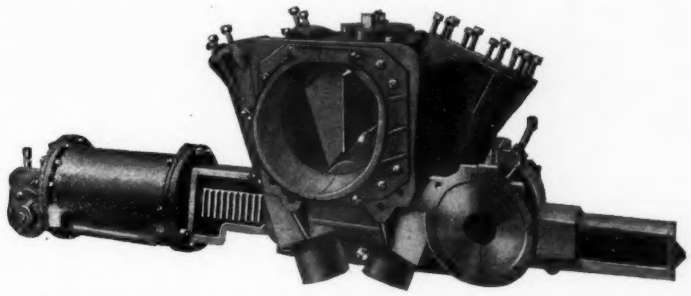
Assembled View of the Duplex Locomotive Stoker Detached from the Locomotive

the elevator casings are screws which raise the coal and allow it to drop into tubes which are fitted into elbows and extend through holes in the backhead on each side of the firedoor. Constant steam jets in the elbows blow the coal through the tubes and distributors located on the inside of the firebox deflect and spread the coal over the entire surface of the fire.

The conveyor consists of a wrought steel trough in which is a cast steel screw and a crushing plate. The screw is driven by gears at the rear end of the conveyor trough through a driving shaft secured along the outside of the trough on the right. The trough is supported under the shovel plate by two angles riveted on each side of the conveyor conduit which forms bearings for rollers fitted on the arms of the conveyor slide support. This support is permanently secured to the bottom of the trough about 3 ft. from its rear end, thus providing flexibility to take care of the movement between the engine and tender. The lower angle bearings extend almost to the front of the tender and form a track on which the trough rolls when being removed from the tender. The conveyor unit moves with the engine, merely resting on the angle bearings in the tender, but when the engine and tender are parted it can be uncoupled from the transfer hopper and left with the tender. An angle ring fits into and around the top of the trough, preventing dust from blowing into the tender tank and coal from rolling over the sides of the trough.

The conveyor driving shaft is in two parts; a gear shaft, which is connected to the conveyor drive gear, and a flexible connection by which it is joined to the conveyor drive and efficient firing, and go on to the transfer hopper. The conveyor is flexibly attached to the hopper by means of a ball joint permanently riveted to the trough and fitting into clamps bolted to the back of the transfer hopper.

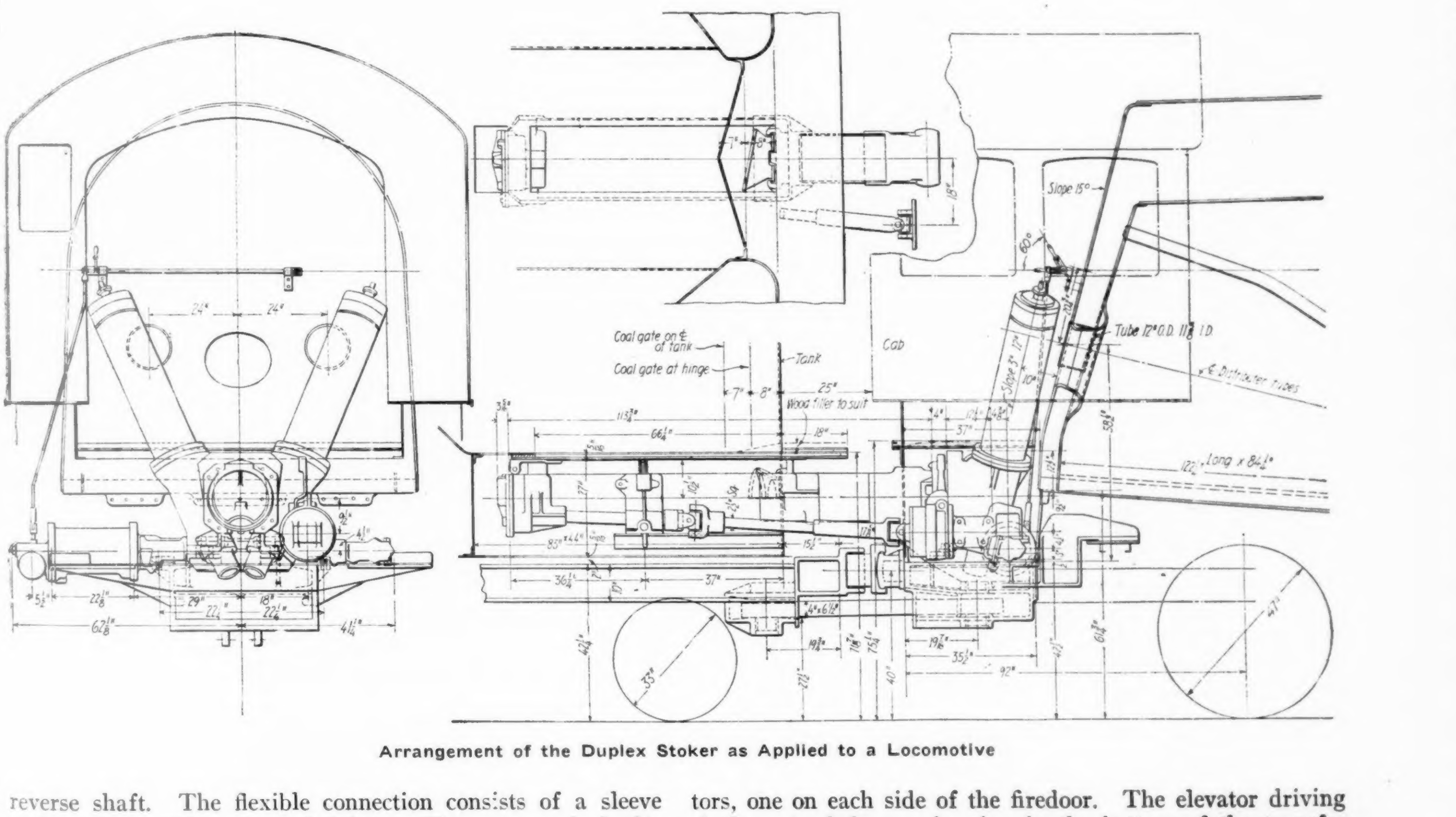
The transfer hopper is a large casting secured to the engine frame beneath the cab deck. The rack housing is bolted to the front bottom portion of the hopper and the elevator cas-



Driving Mechanism of the Duplex Locomotive Stoker Showing the Vance for Distributing the Coal to the Vertical Screws

ings are bolted to the top. At the bottom are bearings for the right and left elevator driving shafts. Secured to the front on a pivot inside the hopper, and dividing the coal coming through the front trough opening, is a dividing rib which can be operated through an opening in the cab deck. By turning this rib to the left or right the supply of coal to either side may be controlled.

There are two elevators raising the coal to the distribu-



Arrangement of the Duplex Stoker as Applied to a Locomotive

reverse shaft. The flexible connection consists of a sleeve and a shaft with universal joints. The square shaft fits loosely into the sleeve, thus furnishing the flexibility in the conveyor shaft made necessary by the movement between the engine and tender. The crusher is at the front end of the opening in the tender deck, and consists of a heavy plate with projections, set in a slide in the trough. The smaller sizes of coal are carried through without crushing or breaking, but the larger lumps are forced against the crusher plate by the conveyor screws and are broken to the proper size for tors, one on each side of the firedoor. The elevator driving shafts extend from a bearing in the bottom of the transfer hopper through the top of the elevator casing and reverse. On the bottom of the shaft is a gear which meshes with the vertical teeth of the rack which drives the shaft. The elevator drive and reverse mechanism is on the same principle as the conveyor drive and reverse, which will be described later, but has two sets of pawls and springs. It has three positions, drive or normal position, in which the elevator raises the coal; neutral position, with the elevator screw

stationary; and reverse, with the screw reversing and allowing the coal to return to the transfer hopper.

The spreading of the coal in the firebox is accomplished by means of the two firing points at the openings through the backhead of the boiler. The firedoor is left undisturbed so that it can be used for hand firing at the roundhouse and on sidings or when drifting. Two elbows, in which firing nozzles are secured, are bolted to the elevator casing. Distributors and tubes combined are attached to these elbows, the tube extending through the openings in the backhead and the distributor, being on the inside of the firebox. The distributor tubes serve as a firing plate and the coal is blown through the tubes on to the underside of the distributor by jets of steam admitted to the firing nozzle. An intermittent action is secured through a constant steam jet and the stopping of coal elevation during the return stroke of the driving engine piston and rack. Peep holes are provided through which the coal supply and the condition of the fire can be observed.

The driving engine consist of a cylinder of 11-in. bore and 17¾-in. stroke with a hollow piston rod and reverse head. The pressure of the steam used by the engine varies from 8 to 80 lb., according to the quality and size of the coal. The pressure is indicated by a special steam gage on the backhead of the locomotive. In normal operation the piston has a power stroke in one direction only, when the piston is traveling toward the center line of the locomotive and the entire stoker mechanism is in normal operation. On the return stroke of the piston the conveying mechanism is normally stationary, but when any of the screws are reversed by means of the reverse mechanism, the return stroke of the piston becomes temporarily a power stroke. The operation of the cylinders is controlled by a reverse head almost identical with the reverse used on the Westinghouse 11-in. air compressor.

The piston rod in the engine cylinder is screwed into a rack which operates the main driving gears. The stroke of the engine is cushioned at either end by steam. In case the stoker becomes clogged or it is desired to reverse it for any reason it can be done by moving the operating rod located on the backhead of the boiler. The return of the operating rod handle to the central position causes the driving engine to resume its normal operation.

The inner cylinder head is cast integral with the housing for the rack. This is a steel forging with teeth cut in the horizontal side which meshes with and drives the conveyor shaft and reverse gear. Another bar of forged steel riveted to this main rod in which teeth are cut in the back space meshes with and drives the shaft on the lower end of the two elevator screw shafts. Removable covers makes the rack accessible at all points.

The conveyor drive and reverse connects the universal joint with the driving rack. Near the front end of the drive shaft is secured the main gear which meshes with the horizontal rack. The drive and reverse body is fitted on a bearing on the shaft next to the ratchet, which is keyed and pressed on the extreme rear of the shaft. On the other side of the drive and reverse body head a joint jaw is cast which connects by a pin with a block in the front universal joint of the flexible connection. A shifter on the drive and reverse body controls the shifting fingers which are set between the three sets of pawls. A shifter lever controls this conveyor drive and reverse which has three positions, drive or normal position, with the stoker running; neutral, with the conveyor screw stationary while the stoker is in motion; and reverse, with the conveyor screw reversing and pulling back the coal instead of letting it go forward. The conveyor drive and reverse units are protected by cast iron casings.

The pressure of steam on the steam jet under working conditions varies from 10 to 25 lb. The distribution is regulated by varying the pressure, which is indicated by a steam gage on the backhead of the boiler, and also by changing the position of the dividing rib. The amount of coal fed can be regulated by varying the speed of the engine. Stokers of this type have been operating successfully for several months and a large number have already been ordered for application to locomotives now being constructed.

BLUE SIGNAL SAFETY DEVICE

The importance of the blue flag, which is used to protect the workmen while repairing cars, should never be underestimated. Any disregard of this signal is liable to cause injury and sometimes death to the men who find it necessary to go under the cars to make the required repairs. The arrangement ordinarily used for protecting such cars consists of a blue flag which is more or less carefully stuck into a tie or into the ground. Often this signal is either knocked down by the wind or by some careless employee, thus offering no protection to the string of cars on which the work is being done. In winter it is difficult to place it in position so that it will remain fixed. Sometimes switchmen will take a chance, remove the flag and place a car on the repair track.

Blue Signal Safety Device Being Applied

This, of course, is contrary to the rules and should never be allowed.

In order to provide a signal which will give ample and positive protection, the Acar Manufacturing Company, 30 Church Street, New York, has recently placed on the market a signal standard which cannot be removed except by the proper authorized person. As shown in the illustration, this blue flag standard is clamped and locked to the rail and can only be removed by the man who carries the key for the lock and when once put in position, it will remain in place. The clamp which fits over the rail is made to fit the shape of the rail and can be applied to rail sections weighing from 56 to 100 lb. The arms of the clamp are riveted together and telescoped in the body of the standard which is a piece of pipe. The upper part of these arms extend out through a slot

in the pipe and the arms are of such shape that as the standard is raised they will open the clamp. As the standard is lowered the clamp grips the rail and holds the standard in an upright position. The eye in the upper end of the arm which extends out through the slot in the pipe will then line up with an eye in the lug on the pipe body so that the standard may be locked in position.

Any kind of a target may be used in the standard. The one shown in the illustration is painted blue with the words "Car Inspector" lettered on it. A hook is provided for a lantern when the standard is used at night. This device is

Blue Signal Safety Device Set in Position

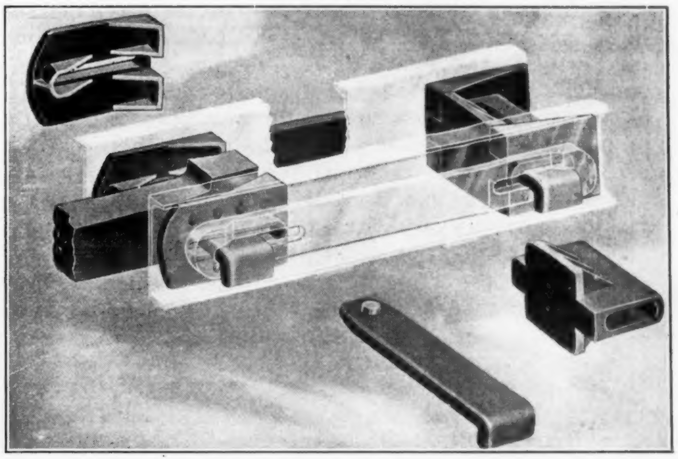
made of substantial material and can be used for a variety of other purposes, such as marking train tracks in passenger stations, protecting team tracks and in any other places where cars are spotted and are not to be disturbed.

MURRAY KEY ATTACHMENT

A new design of draft gear key attachment has been placed on the market by the Keyoke Railway Equipment Company, Chicago, Ill. The device consists of two slotted links outside the draft sills at each end of which are placed draft keys of the usual standard dimensions. The front draft key passes through the coupler and draft lugs while the rear key passes through a key housing which fits in a recess in the rear integral draft lug casting. The slots in the front draft lug castings are of such a length that when the limit of capacity of the draft gear is reached the front key takes a bearing on the lug. This relieves the side links and draft keys of all stresses in excess of the cushioning capacity of the gear. It is intended that a coupler with extensions at the rear of the key slot be used with this device, thus changing the stresses on the front key from bending to compression when the key comes in contact with the front draft lugs.

The rear draft key has a bearing in the key housing for the full distance between the draft sills, which reduces the force tending to bend the key. Sufficient clearance is allowed in the slots in the draft lugs and links so that when the draft gear is closed under compression there are no stresses on any of these members. The draft keys and side links are made of rolled steel, while the front and back draft lugs and key housing are of cast steel.

The following advantages are claimed for this type of



New Design of Keyoke Draft Gear Attachment

construction: It eliminates the bending of draft keys. It permits of using all the space between the draft sills for draft gear. It provides for tying the draft sills together at the rear of the draft gear where buffing shocks are transmitted to the underframe. It facilitates the application of either the draft gear or the key attachment and makes it possible to remove or replace either without disturbing the other. It permits of quick removal or replacement of the coupler. This attachment can be designed to accommodate any type of friction draft gear which is placed wholly between the sills.

POSITIVE LOCKING POWER REVERSE GEAR

During the 1916 conventions of the Master Mechanics' and Master Car Builders' Associations at Atlantic City, a power reverse gear provided with a positive friction lock was exhibited by the Pittsburgh Locomotive Power Reverse Gear Company, Pittsburgh, Pa., and a description of the gear was published on page 1440 of the June 19, 1916, issue of the *Daily Railway Age Gazette.* Since that time the operating mechanism of the gear has been materially altered in order to simplify the cab equipment.

In the original design the movement of the rotary valve, which controls the admission and exhaust of air from the operating cylinder and lock chamber, was controlled by an arrangement of two sliding bars placed in the cab. To the upper bar was attached the operating handle. On the upper face of the lower bar were provided two rollers which worked in a double offset longitudinal slot in the upper bar, causing a lateral movement of the lower bar when the upper bar was moved longitudinally. The lateral movement of the lower bar actuated the rotary valve. The lapping of the valve, which automatically released the air pressure from the operating cylinder and admitted pressure to the chamber above the locking diaphragm was brought about by the longitudinal movement of the lower bar through its connection with the crosshead on the operating piston rod, the normal relation of the upper and lower bar being thus restored.

The cab arrangement with this construction was awkward because of the length required for the moving bars and their guides. Without changing the functions of the gear, the double bar operating mechanism has been substituted by a

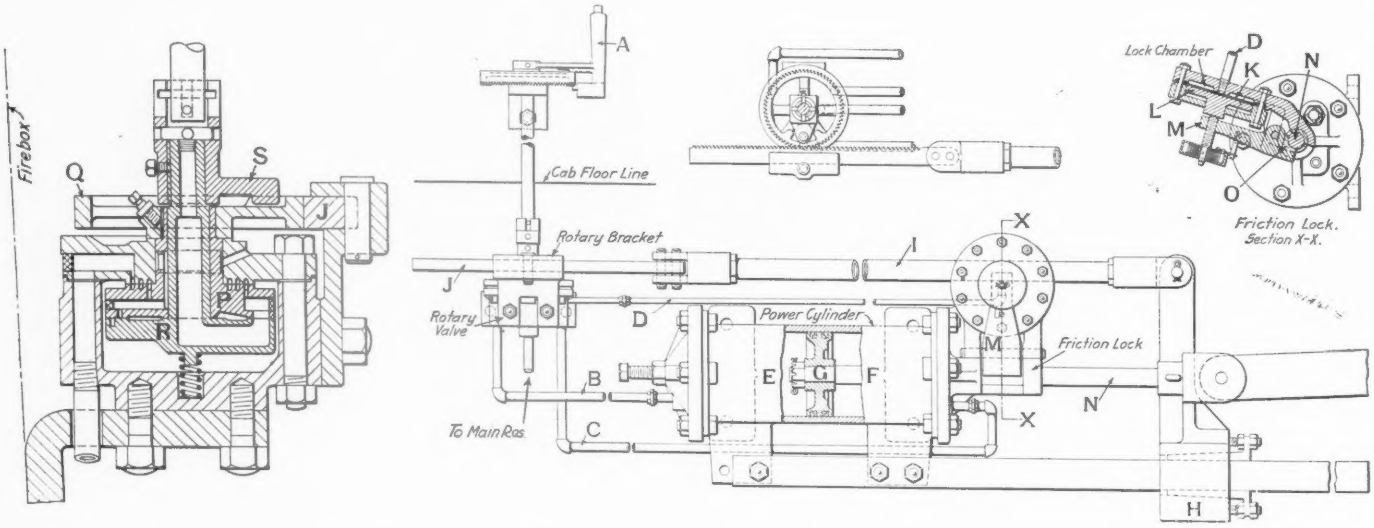
rack and pinion lapping device placed below the cab floor, while the graduating valve is directly operated by means of a rotary handle and circular toothed quadrant in the cab. This provides a cab equipment which is compact, and which is no more difficult to operate than the automatic brake valve.

By referring to the sectional view of the operating valve in the accompanying drawing it will be seen that the moving parts are two rotary disks. The main valve *P* on its upper face is seated against the valve chamber cap. The upper end of the hollow stem of this valve carries the toothed pinion *Q* and this meshes with the rack *J*, the connection of which with the crosshead of the operating piston is clearly shown in the drawing. The ports in the upper face of the main valve are so arranged that registration is maintained throughout a complete revolution. The lower, or graduating valve *R*, is seated against the lower face of the main valve. The graduating valve stem passes up through the hollow stem of the main valve and is attached at its upper end to the reverse lever *A* through an operating shaft and the coupling sleeve *S*.

The normal relation of the graduating valve and main valve is such that the ports leading to the two ends of the operating cylinder are both connected to the atmosphere, while the locking diaphragm is in direct communication with the source of pressure. Any movement of the reverse lever *A* and graduating valve immediately releases the pressure in the lock chamber to the atmosphere and admits pressure either to the rear or forward end of the operating cylinder, depending upon whether the reverse lever is moved forward or backward. The resulting movement of the operating piston causes a corresponding movement through the rack and pinion of the main valve which is thus caused to follow the movement of the graduating valve. The two valves assume their normal or neutral position relative to each other immediately after the movement of the reverse lever ceases, air pressure then being released from the operating cylinder to the atmosphere and admitted to the lock chamber.

It is evident that the position of the block in the link is determined solely by the position of the reverse lever and is unaffected by the condition of the operating piston rings and piston rod packing or by the condition of the valve itself. Leakage can only increase the air consumption during the short periods that the parts are actually in motion.

It will be noted that the connecting sleeve which joins the operating rod to the graduating valve stem, is provided with an arm on the end of which is a downward projecting lug. This lug operates in a short recess in the upper face of the pinion and limits the extent to which the graduating valve may be moved ahead of the main valve. Under normal conditions, with air pressure available, the movement of the piston in the operating cylinder promptly follows that of the graduating valve and reverse lever, which may thus be moved quickly from any position in the quadrant to any other desired. Should an attempt be made to move the engine in the roundhouse before the pump is started, however, no movement of the piston will follow the operation of the reverse lever in the cab and this condition is immediately brought to the attention of the hostler or engineman by his inability to move the reverse lever beyond the comparatively narrow limits of the recess in the face of the pinion. The position of the reverse lever is thus an indication of the position of the link in the block whether pressure is available to operate the gear or not and it is impossible to move the reverse lever from one position to another only to find after the engine has been started that the position of the link blocks has been changed.



General Arrangement and Sectional Elevation of the Rotary Valve of the Snyder Power Reverse Gear

The locking device on the new gear remains essentially the same as that which was previously described. Although designed primarily for operation with air pressure, this reverse gear may be arranged for operation with steam.

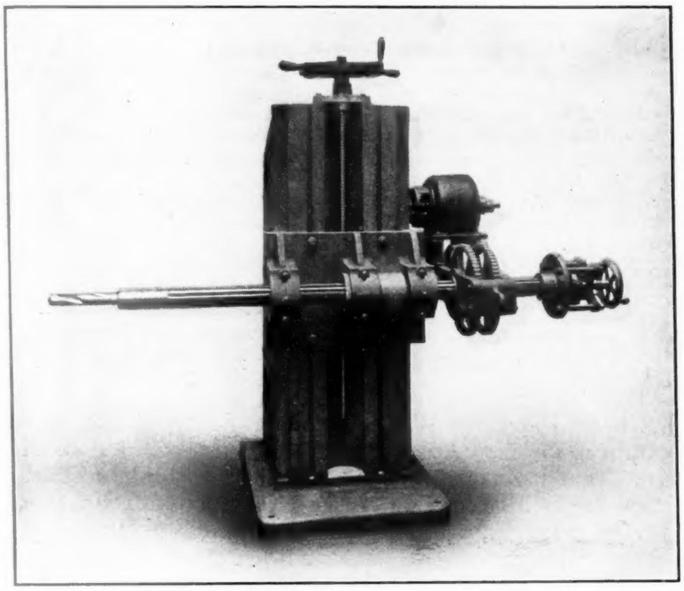
PORTABLE COLUMN BORING BAR

The illustration shows a small portable column boring bar which has recently been designed by the Pedrick Tool & Machine Company, Philadelphia, Pa. As shown, the column of the machine is mounted on a base for use on a floor plate, but for boring or drilling parallel holes in large pieces, the column may be mounted on a long bed, the axis of which is placed at right angle to the center line of the bar. In the design of this tool, effort has been directed toward securing the greatest possible simplicity. While this in a measure limits the range of its usefulness in comparison with larger and more expensive standard floor boring machines, it is the belief that under many conditions this is not of sufficient importance to overcome the advantages which simplicity affords.

The bar is driven through a train of powerful compound gearing by an electric motor which is mounted on brackets supported from the gear housing. Connection from the motor to the gearing train is made through a second system of gearing which is carried on a movable arm. The speed of the bar is changed by using different sizes of gears on this arm. The compound gears are also arranged to be

driven directly from the primary pinion shaft or through the intermediate gear shaft, a change of driving speed also being effected in this manner. The bar is provided with a new constant feed arrangement having three changes which are available for either direction of operation.

The design of the boring bar differs materially from the usual practice, the arrangement being such that the bar may be used either fixed or traveling and changed from one method of operation to the other almost instantly. As is the case with the standard portable boring bar manufactured by the same company, a square thread feed screw is contained in a groove in the bar of this machine. The screw is supported in bronze bearings of special design to take the thrust and a cutter head engaging the feed screw



Portable Column Boring Bar of Simple Design

by a half-nut, travels along the bar. When used in this manner with the bar fixed, the outer end is supported by a column of conventional design with a movable bearing to facilitate the proper alinement of the bar. When possible to use the tool in this manner, the advantages are clearly apparent as the bar does not have to be twice the length of the work, and the work is placed close to the main bearing where the bar is rigidly supported. With the bar fixed the capacity of the machine ranges from bores of $3\frac{1}{2}$ in. to 24 in. diameter.

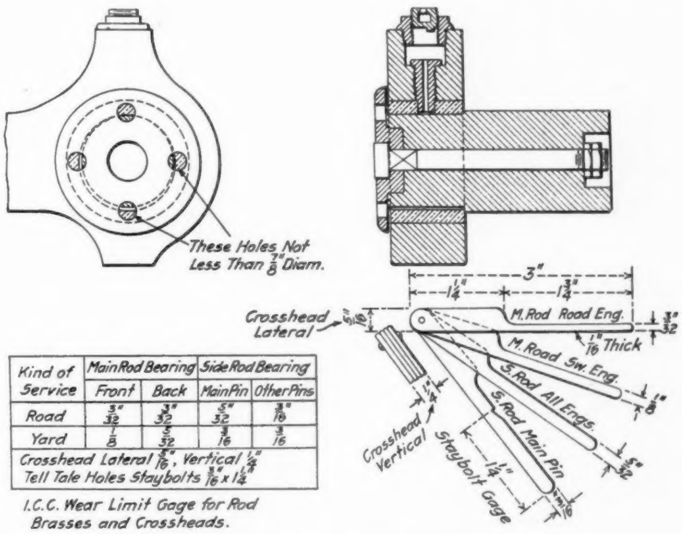
Conditions are often encountered which call for the use of a bar capable of boring long holes of small diameter. Heretofore it has been impossible with this type of bar, to bore holes through which the bar itself could not be passed, and as the smallest practicable diameter of bar is fixed by the necessity of providing a feed screw of reasonable strength, a considerable range of the smaller bores is thus unprovided for. In order that work of this kind may be handled, the bar has been designed to travel, just as would the spindle of a drill press or boring machine. In the end of the bar is a Morse taper socket for the insertion of drills or auxiliary bars. Where used for boring out small bearings an auxiliary bar with a fixed tool, properly supported at the outer end, may be used, the travel of the tool being effected by the travel of the main bar.

The bar has a vertical adjustment on the column ranging from $14\frac{1}{2}$ in. to $56\frac{1}{2}$ in. above the floor plate, thus providing a vertical travel of the saddle on the column of 42 in. The travel of the cutter head on the bar is 48 in. while the travel of the bar itself is 54 in. for the $3\frac{1}{2}$ in. bar, these dimensions being respectively 52 in. and 45 in. for the 4 in. and $4\frac{1}{2}$ in. bars. The net weight of the column with base plate is 2,900 lb., while the machine complete, mounted on a bed, ranges from 4,200 to 4,500 lb., depending on the size of the bar. A motor of $1\frac{1}{2}$ hp. rating is required for the $3\frac{1}{2}$ in. bar; a 2 hp. motor is required for the two larger bars.

CRANK PIN INSPECTION GAGE

The government rules for the inspection of locomotives increase the cost of inspecting engines and require considerable time, particularly when the monthly inspection is made. To reduce the delay incident to the inspection of main and side rod bearings, P. J. Colligan, master mechanic of the Rock Island at Chicago, has devised an ingenious method, the main features of which are now protected by patent. Mr. Colligan's invention covers crank pin collars with holes cored or drilled opposite the edge of the pin, making it possible to insert a gage or feeler between the pin and the bushing to determine the amount of wear. A special gage is provided which has sections of the proper thickness for main rods or side rods of either road or yard engines. It is only necessary to select the proper feeler for the pin which is being inspected and insert it through the hole in the collar which shows the greatest opening. If the gage will pass between the brass and the pin, the limit of wear has been reached. This gage is shown in the illustration. As will be seen, it also provides a means of determining what the allowable limit has been reached on crossheads and one section serves as a staybolt gage.

This method of inspection possesses numerous advantages. It saves the time consumed in removing and replacing col-



Kind of Service	Main Rod Bearing		Side Rod Bearing	
	Front	Back	Main Pin	Other Pins
Road	3/32"	3/32"	5/32"	3/16"
Yard	1/8	5/32	3/16	3/16
Crosshead Lateral 5/16", Vertical 1/4" Tell Tale Holes Staybolts 3/16" x 1 1/4"				

I.C.C. Wear Limit Gage for Rod Brasses and Crossheads.

Colligan Crank Pin Collar and Inspection Gauge

lars and reduces the chances of collars becoming loose due to their being improperly re-applied. In some cases the wear of bushings is determined by raising the rod with a bar and measuring the amount of movement. This method is inaccurate, as oftentimes there is a considerable thickness of grease between the surfaces, or the rods are held rigidly by the crank pins. Neither of these factors interferes with the use of the gage devised by Mr. Colligan. The holes in the crankpin collars make it easy for the engineer to locate a "pound" in the rods and thus save unnecessary labor in the roundhouse. It can also be used to tell when a sufficient amount of grease has been fed to the bearings.

The expense of drilling holes in the collars is small and for new work or renewals the opening can be cored. This arrangement has been applied to a large number of engines. The Jerome-Edwards Metallic Packing Company, Chicago, is handling the sale of this device.

Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION
with which the AMERICAN ENGINEER was incorporated)

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Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' Associations, payable in advance and postage free: United States, Canada and Mexico, $2.00 a year; Foreign Countries (excepting daily editions), $3.00 a year; Single Copy, 25 cents.

WE GUARANTEE, that of this issue 9,100 copies were printed; that of these 9,100 copies 7,998 were mailed to regular paid subscribers, 118 were provided for counter and news companies' sales, 291 were mailed to advertisers, 189 were mailed to exchanges and correspondents, and 504 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 63,747, an average of 9,106 copies a month.

The RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Both houses of Congress have now passed the bill increasing the membership of the Interstate Commerce Commission, but with differences which will necessitate reference to a conference committee.

Three of the all-steel cars authorized some time ago by Congress for the mine-safety service of the Bureau of Mines have just been delivered, and will take the place of three of the old cars which have been in operation since 1910. These cars are to be located at Reno, Nev.; Raton, N. Mex., and Butte, Mont.

The Interstate Commerce Commission has begun the work of moving from its present quarters, scattered through four different buildings in Washington, to its new office building at Eighteenth street and Pennsylvania avenue, where all of its departments will have modern and commodious quarters under one roof.

The Executive Committee of the National Defense Committee of the American Railway Association has notified the railroads of the country that the Secretary of War has approved the suggestion of the committee that the holding of conventions which stimulate passenger travel be discouraged, at least until the railroads are more nearly able to handle the freight business that is being offered.

The Railway Fuel Company, with capital stock of $10,000, has been organized at Birmingham, Ala., and has acquired coal lands to the extent of 2,000 acres or more, in Walker county, Alabama. The president and other officers of the company are officers of the Southern Railway Company, and it is said that the purpose is to furnish coal for use in the locomotives and in the shops of that railroad.

Charles Gates Dawes, president of the Central Trust Company, Chicago, has been recommended for the position of lieutenant-colonel in the seventh regiment of the railway contingent of nine regiments being organized by S. M. Felton, president of the Chicago Great Western. If his commission is approved, Mr. Dawes will be assigned to duty at Atlanta, Ga., where the seventh railway regiment is now being recruited.

The Interstate Commerce Commission has announced a postponement of the effective date of its locomotive headlight order issued last December. The commission's requirements as to headlights will apply to all locomotives constructed after October 1, 1917, instead of July 1, and for locomotives constructed prior to that date the changes required are to be made the first time they are shopped for general or heavy repairs after October 1, but all locomotives are to be equipped by July 1, 1920.

In the discussion of the emergency shipping fleet section of the Deficiency Appropriation bill in the Senate on May 16, Senator Hoke Smith, of Georgia, proposed an amendment to the bill, which authorized the purchase of ships for carrying freight, appropriating $100,000,000 for the purchase of freight cars. The amendment would reduce to that extent the appropriation for an emergency merchant fleet. The amendment provided that the cars shall be used by railroad companies under such terms and for such compensation as may be approved by the President.

The Southern Pacific recently compiled statistics showing comparative prices of railway materials in May, 1915, and May, 1917. Prices of locomotives have increased approximately 75 per cent, the price of the Pacific type, for instance, advancing from $27,000 to $47,290. Passenger cars have increased 50 per cent in cost, the price of a steel chair car in 1915 being $12,500 as compared with $18,750 in 1917. Various types of freight cars have increased from 60 to 85 per cent in price. Steel underframe box cars which cost $1,255 in 1915 now command a price of $2,010.

Senator Pomerene has introduced in Congress a joint resolution, S. J. Res. 77, to provide for the regulation of the production, sale and distribution of coal during the war. The resolution authorizes the President to fix the prices of coal, and to regulate the methods of sale, routes of transportation, and apportionment of coal among merchants and consumers, either directly or through the Federal Trade Commission, or such other agency as he may designate, for the period of the war or for such time as he may consider necessary. If a coal mine operator or dealer conducts his business in a manner prejudicial to the public interest, the President is authorized to take over the business.

Increased Pay for Shop Men

The Louisville & Nashville has made a general increase in the pay of shop men, said to affect 8,000 men; and for most of these men the workday has been reduced from nine hours to eight hours. The pay of machinists and boilermakers has been increased from 42 cents an hour to 48 cents.

The Nashville, Chattanooga & St. Louis has increased the pay of shopmen on a basis substantially the same as that which has been announced by the Louisville & Nashville.

The Chicago, Milwaukee & St. Paul has granted to its machinists, to the number of about 2,000, an increase in pay of 8½ cents an hour, effective from May 1.

It is announced at Paducah, Ky., that the shopmen of the Illinois Central, and also those of the Yazoo & Mississippi Valley, have received an advance in pay amounting to 1½ cents an hour.

The Canadian Northern has increased the pay of shopmen throughout the company's lines. It is said that the rates on all divisions, from Lake Superior to the Pacific Coast, are now uniform, the increases west of Winnipeg being less than those east of that point.

The Canadian Pacific has advanced the pay of shopmen 6 cents an hour, the increase being granted to all employees belonging to the federated unions. According to a statement in a Montreal paper, several hundred women are included in this advance. This road increased the pay of trainmen last month.

MEETINGS AND CONVENTIONS

International Railroad Master Blacksmiths' Association.—At a meeting of the executive committee of the International Railroad Master Blacksmiths' Association held in Chicago on May 26, it was voted to postpone for one year the annual meeting of the association, which was to have been held in August at Chicago.

American Railway Tool Foremen's Association.—At a joint meeting of the officers and executive committees of the American Railway Tool Foremen's Association and the Supply Association held at the Hotel Sherman, Chicago, June 2. 1917, it was unanimously voted that the ninth annual convention of the association should be postponed for one year. The American Railway Tool Foremen's Association and the Supply Association jointly donated the sum of $50 to the American Red Cross. The secretary-treasurer has been instructed to publish the 1917 Year Book as heretofore.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention postponed.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago. Convention postponed.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel La Salle, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, Albany, N. Y. Convention postponed.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio. Convention postponed.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 547 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn. Convention postoned.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention postponed.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Bldg., Chicago. Convention postponed.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 11, 1917, Hotel La Salle, Chicago.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio. Convention postponed.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

G. H. BUSSING, superintendent of motive power and equipment of the Mexico Northwestern, has been promoted to general superintendent in charge of the transportation, maintenance of way and mechanical departments, with office at Ciudad Juarez, Chihuahua, Mexico. The position of superintendent of motive power and equipment has been abolished.

E. B. HALL, assistant to the general superintendent of motive power of the Chicago & North Western at Chicago, Ill., has been appointed acting assistant superintendent at Milwaukee, Wis., succeeding P. Campbell, granted leave of absence.

WILLIAM SCHLAFGE, general mechanical superintendent of the Erie, is now located at Meadville, Pa. The headquarters of both the mechanical and stores departments have been removed from New York to Meadville.

CARL SCHOLZ, manager of the mining and fuel department of the Chicago, Rock Island & Pacific at Chicago, has been appointed mining engineer of the Chicago, Burlington & Quincy, with the same headquarters. Mr. Scholz was born at Slawentzitz, Germany, on July 2, 1872. He was educated in mining engineering at the Royal Gymnasium at Beuthen, Germany, and came to theUnited States in 1889. From 1891 to 1895, he was mining engineer for the Mount Carbon Company, Powellton, Va. From the latter date until 1901, he was part owner and manager of the Thomas Scholz Company, the Superior Coal & Lumber Company, and the Railway Extension Company, of Mammoth, W. Va., the Riverside Coal Company, of Riverside, W. Va., and the Carbon & Coke Company, Carbon, W. Va. In August, 1902, he became connected with the mining department of the Chicago, Rock Island & Pacific, and later was manager of the mining and fuel department, at the same time being president of the Rock Island Coal Mining Company and the Coal Valley Mining Company and director of the Improved Combustion Company and of the Crawford County Mining Company. He has been president of the American Mining Congress for three terms, and in 1910 was sent to Europe by the United States Bureau of Mines to investigate and report on mining conditions. As mining engineer of the Burlington he will have charge of the development of the southern Illinois coal properties of that road.

Carl Scholz

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

A. E. DALES, heretofore division master mechanic of the Canadian Pacific at Edmonton, Alta., has been appointed division master mechanic at Calgary, Alta.

G. H. LIKERT, general foreman of the locomotive department of the Chicago, Rock Island & Pacific, at Horton,

Kans., has been appointed master mechanic of the Colorado and Nebraska divisions, with headquarters at Goodland, Kans., succeeding M. B. McPartland, resigned.

F. WILLIAMS has been appointed superintendent and master mechanic of the Gulf, Florida & Alabama, with headquarters at Pensacola, Fla. He succeeds J. P. Lynahan, superintendent, and B. Dotson, master mechanic, resigned.

W. H. WORTMAN, formerly division master mechanic of the Canadian Pacific at Calgary, Alta., has been appointed division master mechanic and trainmaster at Cranbrook, B. C., succeeding G. Moth.

CAR DEPARTMENT

P. S. WALTER has been appointed general car inspector of the Pennsylvania Lines West of Pittsburgh, Southwest system, with office at Columbus, Ohio, succeeding Charles F. Thiele, promoted.

SHOP AND ENGINEHOUSE

L. F. VON BLUCHER, roundhouse foreman of the Gulf, Colorado & Santa Fe at Galveston, Tex., has been recommended for first lieutenant in the Third Reserve Engineers.

S. HAYWARD, heretofore locomotive foreman of the Canadian Pacific at Swift Current, Sask., has been appointed locomotive foreman at North Bend, B. C., succeeding John MacRae, transferred.

JOHN MACRAE, formerly locomotive foreman of the Canadian Pacific at North Bend, B. C., has been appointed locomotive foreman at Swift Current, Sask., succeeding S. Hayward, transferred.

STEPHEN E. MUELLER, general foreman of the locomotive department of the Chicago, Rock Island and Pacific at Cedar Rapids, Ia., has been recommended for first lieutenant in the Third Reserve Engineers.

F. P. NASH, general foreman of shops of the Illinois Central at Palestine, Ill., has been recommended for a commission as first lieutenant in the Illinois Central company of the Chicago railway regiment, the Third Reserve Engineers.

E. P. POOLE, supervisor of tool equipment and piecework of the Baltimore & Ohio at Baltimore, Md., has been promoted to assistant superintendent of the Mt. Clare (Baltimore) shops.

J. S. TEMPLE has been appointed supervisor of tool equipment and piecework of the Baltimore & Ohio, with headquarters at Baltimore, Md., succeeding E. P. Poole, promoted. Mr. Temple has been for some time in the department, having supervision over tool equipment and piecework.

PURCHASING AND STOREKEEPING

BENJAMIN S. HINCKLEY, purchasing agent of the Boston & Maine at Boston, Mass., resigned on July 1 to go into other business. Mr. Hinckley has been in railroad service since August 1, 1899, and has been purchasing agent of the Boston & Maine since July, 1911.

W. J. HINER, assistant purchasing agent of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed purchasing agent at Cincinnati, Ohio, succeeding George Tozzer, retired.

A. W. MUNSTER, general storekeeper of the Boston & Maine, at Boston, Mass., has been appointed purchasing agent, succeeding B. S. Hinckley, resigned.

COMMISSION APPOINTMENT

CHARLES A. NELSON, heretofore with the Delaware & Hudson Company, has been appointed junior railway mechanical engineer in the division of valuation of the Interstate Commerce Commission, Eastern district, with office at Washington, D. C.

SUPPLY TRADE NOTES

Jack Coughlin, treasurer of the Railway Motor Company of America, died at his home in Chicago on June 7.

The Mahr Manufacturing Company, Minneapolis, Minn., has opened an office at 120 Liberty street, New York, in charge of J. R. Matthews.

The New York offices of the General Electric Company were moved on June 16 from 30 Church street to the Equitable building, 120 Broadway. The entire twentieth floor of the building will be occupied by the company.

The Barco Brass & Joint Company, Chicago, announces that on July 1 the name of the company was changed to Barco Manufacturing Company.

W. P. Steele has been appointed western representative of the American Locomotive Company, with headquarters in the McCormick building, Chicago.

James H. Slawson, sales agent of the National Malleable Castings Company at Chicago, has been elected vice-president of the Joliet Railway Supply Company, with headquarters at Chicago. Mr. Slawson was born at Cleveland, Ohio, and entered railway service in 1890 with the Lake Shore & Michigan Southern in the same city. He was successively employed in the office of the assistant general freight agent, in the revision department, the tariff bureau, the auditing department and the office of the chief engineer. In 1902 he was employed by the National Malleable Castings Company at the Sharon (Pa.) plant with special railroad duties. He was later made chief clerk, following which he was promoted to local treasurer in charge of the business affairs of the Sharon plant, and in 1912 was transferred to Chicago as sales agent. The Joliet Railway Supply Company, of which he becomes vice-president, is a subsidiary of the Northwestern Malleable Iron Company of Milwaukee, Wis.

J. H. Slawson

The Illinois Steel Company, Chicago, announces the appointment of C. H. Rhodes, of the Canadian Steel Company, as purchasing agent, succeeding J. C. Hoot.

J. A. Meaden, vice-president of Paul Dickinson, Inc., Chicago, has resigned to become sales manager of the Automatic Screw Machine Products Company, Chicago.

Brown & Company, Inc., Pittsburgh, Pa., makers of fine irons and steels, has changed the location of its New York office from 50 Church street to Room 2038, Grand Central Terminal.

W. L. Garland, sales representative of the Safety Car Heating & Lighting Company at Philadelphia, Pa., has also been appointed representative of the Vapor Car Heating Company, Inc.

The Steel Car Company, Cleveland, Ohio, has placed a new plant in operation for the repair of wooden cars. The

company is planning to put up another building for the repair of steel cars.

W. W. Hall, formerly Pittsburgh sales manager of the Republic Iron & Steel Company, has been appointed assistant general manager of the Columbia Steel & Shafting Company, Pittsburgh, Pa.

H. F. Bigler, Jr., has been transferred to the railway department of the A. M. Byers Company, Pittsburgh, Pa., and from now on will devote all of his time to railway work, assisting S. P. Broome.

Karl W. Bock, formerly secretary and assistant to the vice-president of the Union Pacific Coal Company, Omaha, Neb., has been appointed manager of the Walter A. Zelnicker Supply Company, St. Louis, Mo.

The Lincoln Electric Company, Cleveland, Ohio, announces that it has appointed as its Indianapolis representative the Ross Power Equipment Company, 617 Merchants' Bank building, Indianapolis, Ind.

J. W. Bettendorf, president and treasurer and J. H. Bendixen, second vice-president and sales manager of the Bettendorf Company, will assume the duties of Robert Parks, who has resigned as general manager.

H. G. Doran & Co., Peoples Gas building, Chicago, has been incorporated to buy and sell mechanical and other devices, with a capitalization of $10,000. Harry G. Doran is president and A. D. Cloud, secretary.

The H. W. Johns-Manville Company has moved its Pittsburgh showrooms to new and larger quarters, and sales offices were opened on the ground floor of the Westinghouse building, corner of Ninth street and Pennsylvania avenue.

Charles H. McCormick, for a number of years connected with the Standard Heat & Ventilation Company, has been appointed special sales agent for the National Railway Appliance Company, at 50 East Forty-second street, New York.

Walter H. Bentley, vice-president of Mudge & Co., Chicago, has been elected president of the Locomotive Specialty Company, Railway Exchange building, Chicago, general distributors of the Ripken main rod arm and other railway specialties.

The Ryan Car Company has started to employ women workers in its works at Hegewisch, Ill., in order to overcome the shortage of labor. On June 25 five women were put to work doing light manual labor such as handling lumber, sorting light material, etc.

Robert Parks, general manager of the Bettendorf Company, Bettendorf, Iowa, has resigned to become connected with the Canadian Car & Foundry Company. It is reported that the Canadian Car & Foundry Company will open their Ft. William (Ont.) plant shortly.

The Dakin Emergency Safety Brake Company, Indianapolis, Ind., has been incorporated with a capital stock of $50,000, to manufacture safety brakes and other devices. G. E. Dakin, M. A. Dakin and Samuel Dakin, all of Stanton, Mich., are directors of the corporation.

The American Steel Export Company, New York, announces the appointment of Charles S. Vought as assistant general manager of sales. Mr. Vought was formerly one of the managers of the order department of the Cambria Steel Company, and has been associated with the American Steel Export Company for some time.

Ralph E. Graves, Pittsburgh representative of the Cleveland Punch & Shear Works Company, Cleveland, Ohio, has been placed in charge of the new office opened by that concern in the McCormick building, Chicago, and will have charge of the middle western territory. T. J. McNamara succeeds Mr. Graves as manager of the Pittsburgh office.

Locomotive Stoker Company

The Locomotive Stoker Company announces the appointments of W. G. Clark as general sales manager, with headquarters at Pittsburgh; F. L. Wassell as Western sales manager, with headquarters in the Railway Exchange building, Chicago, and O. B. Capps as eastern sales manager, with headquarters at 50 Church street, New York.

W. G. Clark

W. G. Clark, prior to his appointment as general sales manager, held the position of western manager of the company. He graduated from Columbia University in 1899 and at once entered the mechanical engineering department of the Metropolitan Street Railway Company in New York. In 1902, he became connected with the Westinghouse interests by entering the engineering department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh. He then went to the Westinghouse Air Brake Company as inspector, and later was representative at St. Louis, Mo. In 1905, he was appointed western manager of Westinghouse, Church Kerr & Co., which position he left to become western manager of the Locomotive Stoker Company, with headquarters at Chicago.

F. L. Wassell

F. L. Wassell, who has been appointed western sales manager, was formerly secretary of the company. Mr. Wassell became associated with the Westinghouse interests in 1910, when he entered the employ of the Westinghouse Air Brake Company at Wilmerding, Pa., as private secretary. He later became assistant secretary of this company. In 1913 he was made secretary of the Locomotive Stoker Company, but it was not until the summer of 1916 that he became actively connected with the Stoker company as its secretary at Pittsburgh.

O. B. Capps

O. B. Capps, who has been appointed to the position of eastern sales manager, was formerly eastern representative. Mr. Capps started work in the mechanical engineering department of the American Locomotive Company at Schenectady, N. Y.

In 1909, he left the Locomotive company to enter the employ of the Locomotive Stoker Company as mechanical expert at Schenectady. In the summer of 1915, he took up the sales work as eastern representative, with headquarters at 50 Church street, New York City, which position he now leaves to become eastern sales manager, as above noted.

C. A. Newman, formerly manager of sales promotion for Henion & Hubbell, Chicago, wholesalers in power pumps, mining and mill supplies, has been made sales manager of the Boiler-Kote Company, with general sales offices in the Fisher building, Chicago.

The Walter A. Zelnicker Supply Company, St. Louis, and allied companies have secured the services of Charles H. Trapp, who is to act as confidential secretary to Mr. Zelnicker, the president. Mr. Trapp was associated with James Stewart & Co. in St. Louis, Denver and Idaho, and lately with Terrell Croft, consulting electrical engineer, St. Louis.

Carl B. Woodworth, general foreman of the Mt. Clare shops of the Baltimore & Ohio, has been appointed a member of the staff of traveling engineers of the American Arch Company. Mr. Woodworth was born in Fort Wayne, Ind., on December 16, 1883. He was educated in the public schools and served a machinist apprenticeship in the Wabash shops in that city. In 1907 he graduated from the mechanical engineering course of Purdue University and then entered the service of the Baltimore & Ohio at Garrett, Ind., as machinist. Subsequently he was appointed roundhouse foreman at Parkersburg, W. Va., motive power inspector at Loraine, Ohio, and acting master mechanic at Benwood, W. Va. He has also served as chief inspector at the Baldwin Locomotive Works and supervisor of shop practice at the Mt. Clare shops.

New Officers of the Westinghouse Electric & Manufacturing Company

At the meeting of the board of directors of the Westinghouse Electric & Manufacturing Company, held at New York on June 20, the board, in addition to declaring a regular quarterly dividend of 1¾ per cent on both preferred and common stock, also declared an extra dividend of ½ of 1 per cent on both common and preferred stock, amounting to $375,000, for the benefit of the Red Cross.

The following officers were elected: Guy E. Tripp, chairman of the board; E. M. Herr, president; L. A. Osborne, Charles A. Terry, H. P. Davis, H. D. Shute, H. T. Herr, and Walter Cary, vice-presidents; T. P. Gaylord, acting vice-president; James C. Bennett, controller and secretary; Warren H. Jones, assistant secretary; H. F. Baetz, treasurer and assistant secretary; S. H. Anderson, assistant treasurer and assistant secretary; L. W. Lyons, assistant treasurer; F. E. Craig, auditor; W. B. Covil, Jr., and W. J. Patterson, assistant auditors.


H. D. Shute

Henry D. Shute, who has been promoted from treasurer to vice-president of the Westinghouse Electric & Manufacturing Company, has been associated with the company since 1893. Mr. Shute was born in Somerville, Mass. He graduated in electrical engineering at the Massachusetts Institute of Technology in 1892. He later spent some time studying in Germany at the School of Mines in Clausthal, and also at the Technical School in Dresden. Mr. Shute has had a wide experience in the Westinghouse company. His first two years were spent in the testing department, and later he was engaged on erection and laboratory work. He subsequently became associated with L. B. Stillwell. For a short time afterwards he was an assistant foreman of the experimental department of the Niagara Falls Power Works. Later he was transferred to the engineering department, where he designed alternating current apparatus, being prominently identified with the steam railroad electrification work done by the Westinghouse company. After five years' service with the company, Mr. Shute took up work in the sales department, in which he remained until 1903 when he was made assistant to the vice-president, L. A. Osborne, which position he filled until 1910, when he was elected acting vice-president. In 1914, Mr. Shute was made treasurer of the company, succeeding T. W. Siemon.


H. T. Herr

Herbert Thacker Herr, who has been elected a vice-president of the Westinghouse Electric & Manufacturing Company, has been identified with the Westinghouse Machine Company since 1908, filling, respectively, the positions of general manager, second vice-president and general manager, and, finally, vice-president and general manager and a director of the company. Mr. Herr was born in Denver, Colo., and received his education in the public schools of Denver and at Yale University. After leaving college he became identified with the following railroads, in various capacities: Chicago & North Western, Denver & Rio Grande, Chicago, Great Western, Atchison, Topeka & Santa Fé, and the Norfolk & Western. In 1906 Mr. Herr was made general superintendent of the Denver & Rio Grande, and two years later retired from the railway field to become vice-president and general manager of the Duquesne Mining & Reduction Company, at Duquesne, Ariz., where he remained until he moved to Pittsburgh. Mr. Herr is officially connected with a number of other industrial and financial institutions, being a director of the Pittsburgh Meter Company, vice-president and director of the Westinghouse Air Spring Company, the Westinghouse Gear & Dynamometer Company, and the Rodman Chemical Company.


Walter Cary

Walter Cary, who has been elected a vice-president of the Westinghouse Electric & Manufacturing Company, was since

1904 associated with the Westinghouse Lamp Company, filling for the greater part of the time the positions of vice-president and general manager. Mr. Cary was born in Milwaukee, Wis., and received his education in the schools of that city, and at Harvard University. After leaving college he became associated with the Gibbs Electric Company, of Milwaukee, as secretary, and in 1889 he, with some other local men, formed the Milwaukee Electric Company, manufacturers of dynamos and motors, becoming its vice-president and in 1902 its president. Mr. Cary is well known throughout the electrical industry on account of his activities in the field of incandescent lighting.

H. F. Baetz

H. F. Baetz, who has been elected treasurer of the Westinghouse Electric & Manufacturing Company, was born and raised in Pittsburgh, and educated in the schools of that city, graduating from Allegheny High School in the class of 1887. On the date of his election as treasurer, Mr. Baetz had just completed to a day 30 years of service with the Westinghouse Electric & Manufacturing Company. Mr. Baetz began his business career as a timekeeper in the Garrison plant of the Westinghouse Electric & Manufacturing Company, and after only one year of service, and at the age of 18, he was made paymaster of the company. Two years later he was transferred to the accounting department, where he worked until 1899, when he was made acting assistant treasurer. In 1902 Mr. Baetz was elected assistant treasurer of the company.

Tuco Products Corporation

The Tuco Products Corporation has recently been organized under the laws of New York, with a capital of $500,000, and has purchased the entire business of the Transportation Utilities Company, of New York, and the Magnesite Products Company, of San Francisco. The former company has been engaged in business with the railroads for more than ten years, handling the "Tuco" brand of insulation and preservation; National car roofing; National and Universal trap doors; Imperial and Universal car screens; Eclipse deck sash ratchets; Perfection sash balances, and Kicker and Wedge locks for trap doors; Flexolith composition flooring; Resisto insulation; Tucolith plastic car flooring; Tucork insulation; Brown weatherstrips; the North Pole drinking fountain; pulverized magnesite and chloride magnesium. The Magnesite Products Company has been established for several years, manufacturing "Klingstone" flooring, magnesite, stucco, plaster and paint.

D. W. Pye

Magnesite is one of the principal materials used in the manufacture of Tucolith plaster car floorings, and the only known suitable supply (low in lime content) heretofore came from the Balkan states. That source being shut off by the war, forced the company to make a search for the right raw material, and after exhaustive laboratory tests and resulting negotiations, the consolidation mentioned was effected, which assures a convenient and apparently unlimited supply. It also makes possible an expansion of the business, by which it is planned to deal with the application of stucco to old wooden passenger stations. There will also be added a complete line of fire-proof wall board, plaster and paints. Arrangements have practically been made for 16 branch agencies to handle the business in different sections of the United States and Canada.

David H. McConnell has been elected chairman of the board. Mr. McConnell has been identified with many large business interests in which his financial genius and business foresight have been a factor in their success. He is at the present time at the head of a large manufacturing business which employs thousands of agents, and is also a director in a number of railway supply companies.

David W. Pye, president of the corporation, is well known in the railway supply field. For 21 years he was connected with the Safety Car Heating & Lighting Company, which company he joined on September 1, 1889, as assistant to the treasurer. Later he was made purchasing agent, and still later made assistant to the president, then second vice-president, and finally vice-president. In 1910 he left that company to become president of the United States Light & Heating Company, and two years later was elected president of the Transportation Utilities Company. Mr. Pye has spent his entire business career of 27 years with large concerns specializing on railway requirements.

Garrett Burgert, vice-president and treasurer, was for 27 years with the Ramapo Iron Works, for the first 10 years as superintendent, and the remaining 17 years as sales manager. He was then elected president of the Metal Plated Car & Lumber Company, in which capacity he served for eight years, or until 1912, when that company was absorbed by the Transportation Utilities Company. He was then made secretary, and in 1916 was elected vice-president.

Harold B. Chamberlain will have direct charge of the railroad sales department. After Mr. Chamberlain left college he spent several years in the mechanical and car departments of the Baltimore & Ohio. He left railway service to accept an appointment in the mechnical department of the Safety Car Heating & Lighting Company. Later he went with the Transportation Utilities Company, and after several months in the plant was assigned to the selling staff.

W. V. V. Clarke has been appointed engineer of plants. Mr. Clarke, a Cornell graduate, has been especially educated in engineering and chemistry. He has for the last few years had charge of certain gas interests in Brooklyn, and will have direct charge of the San Francisco, Chicago and New York plants.

Thomas Berry, one of the founders of the firm of Berry Brothers, varnish manufacturers, Detroit, Mich., died at his home in that city on May 24. Mr. Berry was born in Sussex, England on February 7, 1829, and came to Detroit in 1856 with his two brothers, with whom he established the firm which bears his name, in 1858. He maintained an active interest in the business until shortly before his death.

L. H. Mesker, formerly sales manager of the Kearney & Trecker Company of Milwaukee, Wis., is now associated with the sales department of the Cleveland Milling Machine Company of Cleveland, Ohio. Mr. Mesker has had wide experience in machine tool sales having been connected with the Motch-Merryweather Company of Cleveland, and Manning, Maxwell & Moore, at St. Louis, Mo., and Cleveland.

Catalogues

Offset Boring Head.—Catalogue F, issued by the Marvin & Casler Company, Canastota, N. Y., describes and illustrates the Casler offset boring head.

Tools.—Tool book No. 13, recently issued by the Goodell-Pratt Company, Greenfield, Mass., is a 432-page booklet descriptive of the company's line of tools of all kinds.

Heating Appliances.—A booklet issued by the Gold Car Heating & Lighting Company, New York, describes that company's thermostatic heat regulating system for public buildings, etc.

Push Button Specialties for small power and light wiring and remote control switches for industrial motors are described in catalogue No. 8, issued by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Sanitary Fixtures for Railway Cars.—Catalogue No. 213, recently issued by the Dayton Manufacturing Company, Dayton, Ohio, is descriptive of the line of Dayton closets, washstands, water coolers, etc., for railway passenger cars.

Metal Hose.—A booklet recently issued by the Pennsylvania Flexible Metallic Tubing Company, Philadelphia, illustrates and describes the company's Penflex metal hose. Several pages of the book are devoted to the use of the hose by railways.

Oxy-Illuminating Gas Apparatus.—Bulletin 101, issued by the Bradford-Ackermann Corporation, New York, is a four-page folder illustrating and describing the "Astra" oxy-illuminating low pressure gas apparatus designed for lead burning purposes.

Vises and Anvils.—The Columbian Hardware Company, Cleveland, Ohio, has issued a catalogue showing its line of vises and anvils. The booklet in its 36 pages contains illustrations of the vises, remarks as to the uses for which they are intended, and lists of sizes and prices.

Rivet Cutting Gun.—The Rivet Cutting Gun Company, Cincinnati, Ohio, has issued a catalogue describing its so-called rivet cutting gun, a pneumatic tool for cutting rivets. The booklet contains a number of illustrations of the gun in use in cutting rivets on freight cars, etc.

Direct Current Motors from 1½ hp. to 40 hp. are described and listed in Bulletin No. 1000 of the Eck Dynamo & Motor Company, Belleville, N. J. The motors included are known as type D, have commutating poles, are ventilated by internal fans and are equipped with self-alining ball bearings.

Ball Bearings in Machine Tools.—This is the title of a very attractive booklet which has been issued by the Hess-Bright Manufacturing Company, Philadelphia. The booklet describes the annular type of ball bearing, and shows its advantages over earlier types. There are several illustrations of the bearings and machines on which they are used.

Boiler Metal Treatment.—The Perolin Railway Service Company, St. Louis, Mo., has recently issued an eight-page pamphlet outlining the service it renders in connection with the treatment of locomotive boilers with Perolin. The pamphlet describes the action of Perolin in removing scale from locomotive boilers and protecting the metal after the scale has been removed.

Flue Welding Apparatus.—The Draper Manufacturing Company, Port Huron, Mich., has issued a booklet descriptive of its pneumatic flue welder for scarfing, welding and swedging boiler tubes, its pneumatic tube welding machines for welding and swedging locomotive superheater tubes, its flue reclaiming attachments, and its ball finishing tools for repairing superheater units.

Tool Grinder.—Catalogue K-4, recently issued by the Gisholt Machine Company, Madison, Wis., describes and illustrates the Gisholt universal tool grinder. The booklet shows the advantages obtained by using the grinder and by keeping tool-post tools in a conveniently located tool room. Several of its pages show how tools are ground by the Gisholt method and a description is given of the grinders themselves.

Freight Car Appliances.—Catalogues Nos. 10, 20 and 30, issued by the Wine Railway Appliance Company, Toledo, Ohio, deal respectively with that company's steel ladders, car ventilating shutters and the Wine self-centering roller side bearing. Each booklet is well illustrated with views of the appliances, plans showing their installation and views of cars on which they have been applied.

Commonwealth Devices.—The open hearth cast steel devices manufactured by the Commonwealth Steel Company, St. Louis, Mo., are described in a pamphlet which the company has recently issued. The booklet illustrates and describes the trucks, underframes, bolsters, draft gear, etc., which the company manufactures. Scattered throughout the booklet are illustrations showing scenes at the company's plants and processes in the manufacture of steel castings.

The Best Way Out.—The Cleveland Twist Drill Company recently put on the market its Ezy-out screw extractors for removing broken set or cap screws, studs, staybolts, etc. The extractors have met with such success that the company has now also put on the market three other sets, in addition to the No. 17 set which was sold originally. These four sets, including 12 sizes of extractors, are described in a folder "The Best Way Out," recently issued by the company.

Riveting Machines.—The John F. Allen Company, 372 Gerard avenue, New York, has recently issued a very complete catalogue showing its portable pneumatic compression and hammer riveting machines. The machines described in the calatogue consist of jaw riveters with 8, 10 and 12 in. cylinders, varying in weight from 775 lb. to 5,200 lb., compression lever riveters, lattice column riveters, alligator riveters, hammer riveters and belt-driven jaw riveter. A complete list of the different parts of these riveting machines is also included in the catalogue.

Wood Block Floors.—The Ayer & Lord Tie Company, Chicago, has issued a 24 page booklet illustrating and describing its interior wood block floors. This book describes the history of wood blocks for floors and pavements; their advantages for interior use from the standpoint of sanitation, comfort, cleanliness and general efficiency; and contains an exposition of the material and workmanship necessary for good results and a list of industrial and commercial structures for which these floors are applicable. The booklet is well illustrated by photographs.

Pipe Threading and Cutting Machines.—The Landis Machine Company, Inc., Waynesboro, Pa., has recently issued Catalogue No. 23 illustrating its pipe and nipple threading machines, pipe threading and cutting machines and chaser grinder. This catalogue contains 45 pages, giving detailed descriptions of these machines together with the size and manner in which they should be ordered. A complete description of the Landis chaser is given and instructions for the application of them to the Landis holder. The descriptions of the pipe threading and cutting machines are given with specifications for the different types, including those with the mechanical speed change and those operated by the variable speed motor. Similar information is given regarding the pipe and nipple machines.